Soil Survey Investigations Report No. 33

Soil Survey Laboratory Data and Descriptions for Some Soils of...

... MINNESOTA

SOIL CONSERVATION SERVICE U.S. DEPARTMENT OF AGRICULTURE
In cooperation with
MINNESOTA AGRICULTURAL EXPERIMENT STATION

Soil survey investigations reports already published:

SSIR No. 1	Soil Survey Laboratory Methods and Procedures for Collecting Soil Samples
SSIR No. 21	A Toposequence of Soils in Tonalite Grus in the Southern California Peninsular Range
	Soil Survey Laboratory Data and Descriptions for Some Soils of:
SSIR No. 2	North Dakota
SSIR No. 3	Iowa
SSIR No. 4	Kansas
SSIR No. 5	Nebraska
SSIR No. 6	Arkansas, Louisiana, and Missouri
SSIR No. 7	Montana
SSIR No. 8	Wyoming
SSIR No. 9	Minnesota
SSIR No. 10	Colorado
SSIR No. 11	Oklahoma
SSIR No. 12	Puerto Rico and the Virgin Islands
SSIR No. 13	Mississippi
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SSIR No. 15	Tennessee
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SSIR No. 17	Wisconsin
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September 1978

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PREFACE

The Soil Survey Investigations Report (SSIR) Series was established to preserve and make available technical information resulting from soil survey investigations. SSIR No. 1, "Soil Survey Laboratory Methods and Procedures for Collecting Soil Samples," revised April 1972, describes in detail the methods used in the soil survey laboratories. One report involves a single specific study. Other reports in the series contain pedon descriptions and data from the individual states and Puerto Rico and the Virgin Islands. The entire series is listed on the inside front cover.

This report contains pedon descriptions and data obtained in Minnesota from 1954 to 1973. The majority of laboratory analyses were conducted at the Soil Survey Laboratory Unit, Lincoln, Nebraska.

Laboratory data for different soils cannot always be compared without allowance for the method. Methods are indexed by code or footnote in data sheet column headings and are identified briefly on the following two pages. Detailed explanations of coded procedures are in SSIR No. 1.

Many of the soil descriptions were prepared as working documents, not necessarily for publication. Some contain unusually detailed information pertinent to specific soil survey investigations. Such information, including older concepts of soil series, relationships among pedons, and field estimates of properties, is useful in a publication of this type. Editing is, therefore, minimal with emphasis toward preservation of descriptive data.

Many pedons no longer represent the soil series with which they were originally identified; a few represent series being considered for reclassification. All were checked against series classification as of December 1976. Some pedons are called taxadjuncts to series. All pedons are classified to the family level. In the taxonomic and geographic indexes pedons are arranged by taxonomic unit.

METHODS CODE SYMBOLS

1. SAMPLE COLLECTION AND PREPARATION
   - A. Field sampling
     - 1. Site selection
     - 2. Soil sampling
       - a. Stony soils
       - b. Marsh and swamp soils
   - B. Laboratory preparation
     - 1. Standard (air dry)
       - a. Square-hole 2-mm sieve
       - b. Round-hole 2-mm sieve
     - 2. Field moist
     - 3. Carbonate-containing material
     - 4. Carbonate-indurated material

2. CONVENTIONS
   - A. Size-fraction base for reporting
     - 1. <2-mm
     - 2. <size specified
   - B. Data sheet symbols
     - tr: trace, not measurable by quantitative procedure used or less than reportable amount
     - - : analysis run but not detected
     - blank: analysis not run
     - nd: analysis not run
     - <: less than reported amount or none present

3. PARTICLE-SIZE ANALYSES
   - A. Particles <2-mm (pipet method)
     - 1. Air-dry samples
       - a. Carbonate and noncarbonate clay
       - b. Fine clay
       - c. Water-dispersible clay
   - B. Particles >2-mm
     - 1. Weight estimates
       - a. By field and laboratory weights
       - b. From volume and weight estimates
     - 2. Volume estimates

4. FABRIC-RELATED ANALYSES
   - A. Bulk density
     - 1. Saran-coated clods
       - a. Field state
       - b. Air dry
       - c. 30-cm absorption
       - d. 1/3-bar desorption I
       - e. 1/3-bar desorption II
       - f. 1/3-bar desorption III
       - g. 1/10-bar desorption
       - h. Oven dry
     - 3. Cores
       - a. Field moist
   - B. Water retention
     - 1. Pressure-plate extraction (1/3 or 1/10-bar)
       - a. Sieved samples
       - b. Soil pieces
       - c. Natural clods
     - 2. Pressure-membrane extraction (15-bars)
       - a. Field-moist samples
     - 3. Sand-table absorption
     - 4. Field state
     - 5. Air dry
   - C. Water-retention difference
     - 1. 1/3-bar to 15 bars
     - 2. 1/10-bar to 15 bars
   - D. Linear extensibility
     - 1. Dry to moist
   - E. Micromorphology
     - 1. Thin sections
       - a. Preparation
       - b. Interpretation
       - c. Moved-clay percentage
   - F. Plasticity index
     - 1. Liquid limit
     - 2. Upper plastic limit

5. ION-EXCHANGE ANALYSES
   - A. Cation-exchange capacity
     - 1. NH_4OAc, pH 7.0
       - a. Direct distillation
     - 2. NaOAc, pH 8.2
       - a. Centrifuge method
     - 3. Sum of cations
       - a. Acidity by $BaCl_2$-TEA, pH 8.2; bases by NH_4OAc, pH 7.0
       - b. Sum of bases plus Al
     - 6. NH_4OAc, pH 7.0 leaching tube
       - a. Direct distillation
   - B. Extractable bases
     - 1. NH_4OAc extraction
       - a. Uncorrected
       - b. Corrected (exchangeable)
       - c. See 5B4
     - 2. KCl-TEA extraction, pH 8.2
     - 3. KCl-TEA, pH 8.2 (revised)
       - a. Uncorrected
       - b. Corrected (exchangeable)
     - 4. NH_4OAc, pH 7.0 (modified)
       - a. Uncorrected
       - b. Corrected (exchangeable)
   - C. Base saturation
     - 1. NH_4OAc, pH 7.0
     - 2. NaOAc, pH 8.2
     - 3. Sum of cations
   - D. Sodium saturation (exchangeable Na pct.)
     - 1. NaOAc, pH 8.2
     - 2. NH_4OAc, pH 7.0
   - E. Sodium-adsorption ratio
   - F. Calcium saturation
     - 1. NH_4OAc, pH 7.0

6. CHEMICAL ANALYSES
   - A. Organic carbon
     - 1. Acid-dichromate digestion
       - a. $FeSO_4$ titration
       - b. CO_2 evolution, gravimetric
     - 2. Dry combustion
       - a. CO_2 evolution I
       - b. CO_2 evolution II
   - B. Nitrogen
     - 1. Kjeldahl digestion
       - a. Ammonia distillation
   - C. Iron
     - 1. Dithionite extraction
       - a. Dichromate titration
       - b. EDTA titration
     - 2. Dithionite-citrate extraction
       - a. Orthophenanthroline colorimetry
       - b. Atomic absorption
     - 3. Dithionite-citrate-bicarbonate extraction
       - a. Potassium thiocyanate colorimetry
     - 4. Pyrophosphate-dithionate extraction
     - 5. Sodium-pyrophosphate extraction
       - a. Atomic absorption
     - 6. Ammonium oxalate extraction
       - a. Atomic absorption
   - E. Calcium carbonate
     - 1. HCl treatment
       - a. Gas volumetric
       - b. Manometric
       - c. Weight loss
       - d. Titrimetric
     - 2. Sensitive qualitative method
       - a. Visual, gas bubbles
   - G. Aluminum
     - 1. KCl extraction I, 30 min.
       - a. Aluminon I
       - b. Aluminon II
       - c. Aluminon III
       - d. Fluoride titration
       - e. Atomic absorption
     - 2. KCl extraction II, overnight
       - a. Aluminon I

6. CHEMICAL ANALYSES (cont.)
   3. NH_4OAc extraction
      a. Aluminon III
   4. NaOAc extraction
      a. Aluminon III
   5. Sodium pyrophosphate extraction
      a. Atomic absorption
   6. Ammonium oxalate extraction
      a. Atomic absorption
   7. Dithionite-citrate extraction
      a. Atomic absorption
H. Extractable acidity
   1. $BaCl_2$-triethanolamine I
      a. Back-titration with HCl
   2. $BaCl_2$-triethanolamine II
      a. Back-titration with HCl
I. Carbonate
   1. Saturation extract
      a. Acid titration
J. Bicarbonate
   1. Saturation extract
      a. Acid titration
K. Chloride
   1. Saturation extract
      a. Mohr titration
      b. Potentiometric titration
L. Sulfate
   1. Saturation extract
      a. Gravimetric, $BaSO_4$
      b. EDTA titration
   2. NH_4OAc extraction
      a. Gravimetric, $BaSO_4$
M. Nitrate
   1. Saturation extract
      a. PDS acid colorimetry
      b. Diphenylamine
N. Calcium
   1. Saturation extract
      a. EDTA titration
      b. Atomic absorption
   2. NH_4OAc extraction
      a. EDTA-alcohol separation
      b. Oxalate-permanganate I
      c. Oxalate-permanganate II
         Fe, Al, and Mn removed
      d. Oxalate-cerate
      e. Atomic absorption
   3. NH_4Cl-EtOH extraction
      a. EDTA titration
   4. KCl-TEA extraction
      a. Oxalate-permanganate
      b. EDTA titration
      c. Atomic absorption
O. Magnesium
   1. Saturation extract
      a. EDTA titration
      b. Atomic absorption
   2. NH_4OAc extraction
      a. EDTA-alcohol separation
      b. Phosphate titration
      c. Atomic absorption
   3. NH_4Cl-EtOH extraction
      a. EDTA titration
   4. KCl-TEA extraction
      a. Phosphate titration
      b. EDTA titration
      c. Atomic absorption
P. Sodium
   1. Saturation extract
      a. Flame photometry
      b. Atomic absorption

6. CHEMICAL ANALYSES (cont.)
   2. NH_4OAc extraction
      a. Flame photometry
      b. Atomic absorption
Q. Potassium
   1. Saturation extract
      a. Flame photometry
      b. Atomic absorption
   2. NH_4OAc extraction
      a. Flame photometry
      b. Atomic absorption
R. Sulfur
   1. $NaHCO_3$ extract, pH 8.5
      a. Methylene blue
   2. HCl release (sulfide)
      a. Iodine titration
S. Total phosphorus
   1. Perchloric acid digestion
      a. Molybdovanadophosphoric acid colormetry

7. MINERALOGY
A. Instrumental analysis
   1. Preparation
      a. Carbonate removal
      b. Organic-matter removal
      c. Iron removal
      d. Particle-size fractionation
      e. PSDA pretreatment
   2. X-ray diffraction
      a. Thin film on glass, solution pretreatment
      b. Thin film on glass, resin pretreatment
      c. Thin film on glass, $NaPO_3$ pretreatment
      g. Powder mount, diffractometer recording
      h. Powder mount, camera recording
   3. Differential thermal analysis
B. Optical analysis
   1. Grain studies
   2. Electron microscopy
C. Total analysis
   1. Chemical
   2. X-ray emission spectrography
D. Surface area
   1. Glycerol retention

8. MISCELLANEOUS
A. Saturated paste, mixed
   1. Saturation extract
      a. Conductivity
      b. Conductivity, quick test
   2. Conductivity, saturated paste
B. Saturated paste, capillary rise
   1. Saturation extract
      a. Conductivity
C. pH
   1. Soil suspensions
      a. Water dilution
      b. Saturated paste
      c. KCl
      e. $CaCl_2$
D. Ratios and estimates
   1. To total clay
   2. To noncarbonate clay
   3. Ca to Mg (extractable)
   4. Estimated clay percentage
   5. Estimated total salt
E. Soil resistivity
   1. Saturated paste

CLASSIFICATION INDEX[1/]

CLASSIFICATION INDEX[1/]

CLASSIFICATION INDEX[1/]

*Page number refers to SSIR 9.

[1/] See Soil Series index for footnotes [2/] through [22/].

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CLASSIFICATION INDEX[1/]
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[1/] See Soil Series index for footnotes 2/ through 22/.

*Page number refers to SSIR 9.

[1/] See Soil Series index for footnotes [2/] through [22/].

SOIL SERIES INDEX

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Adolph	S57MN-48-5	Haplaquoll	5*
Ahmeek taxadjunct	S68MN-9-2	Fragiboralf	3
Anoka	S61MN-30-1	Glossoboralf	7*
Anoka taxadjunct	S61MN-30-2	Eutroboralf [2]	9*
Arveson taxadjunct	S67MN-54-1	Calciaquoll	5
Arveson taxadjunct	S67MN-54-2	Calciaquoll	7
Automba	S68MN-9-9	Eutroboralf	9
Barbert taxadjunct	S69MN-7-4	Argialboll	11
Blackhoof	S68MN-9-3	Humaquept	13
Brainerd	S54MN-18-32B	Fragichrept [3]	53*
Brainerd taxadjunct	S54MN-18-33A	Fragiboralf [4]	11*
Canisteo	S54MN-81-113A	Haplaquoll [5]	67*
Canisteo	S54MN-81-113HB	Haplaquoll [6]	73*
Cathro	S72MN-35-4	Borosaprist	15
Cathro	S72MN-60-1	Borosaprist	17
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Cordova	S54MN-81-113HA	Argiaquoll [7]	71*
Cordova	S69MN-7-11	Argiaquoll	21
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Fayette	Z-1-2-8(75-89)	Hapludalf	23*
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Flak taxadjunct	S54MN-18-34A [10]	Fragiboralf	29*
Flaming	S67MN-54-4	Haploboroll	29
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Formdale	S57MN-75-2	Haploboroll	33
Guckeen	S69MN-7-2	Hapludoll	35
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Hayden taxadjunct	S60MN-86-2 [11]	Hapludalf	33*
Hattie	S61MN-75-1 [12]	Haploboroll	63*
Hattie	S61MN-75-2 [12]	Haploboroll	65*
Hibbing	S64MN-69-2	Eutroboralf	37
Hibbing taxadjunct	S64MN-69-1	Glossoboralf	39
Hiwood	S61MN-39-1	Udipsamment	35*
Hiwood	S61MN-39-2	Udipsamment	37*
Kasson	S70MN-20-2	Hapludalf	41
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Markey	S72MN-35-3	Borosaprist	55
Marna	S69MN-7-1	Haplaquoll	57
Maxcreek taxadjunct	S70MN-24-1	Haplaquoll	59
Menahga	S61MN-80-1	Udipsamment	47*
Menahga	S61MN-80-2	Udipsamment	49*
Milaca	S63MN-5-3	Fragiochrept	61
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Minnetonka	S69MN-7-12	Argiaquoll	65
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SOIL SERIES INDEX

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Nokay taxadjunct	S54MN-18-32A 13/	Fragiboralf	51*
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Sartell	S60MN-71-2 15/	Udipsamment	55*
Sartell	S60MN-71-3 15/	Udipsamment	57*
Sartell	S60MN-71-1 16/	Udipsamment	77*
Sartell	S60MN-71-4 16/	Udipsamment	79*
[illegible]	MN-SCD-4-(40-46) 17/	Hapludalf	21*

SOIL SERIES INDEX

1/ County numbers (the number following "MN" in the Soil Survey No.) are as follows:

5. Benton	48. Mille Lacs
7. Blue Earth	50. Mower
9. Carlton	54. Norman
18. Crow Wing	60. Polk
20. Dodge	66. Rice
23. Fillmore	69. St. Louis
24. Freeborn	71. Sherburne
28. Houston	75. Stevens
30. Isanti	80. Wadena
31. Itaska	81. Waseca
35. Kittson	84. Wilkin
36. Koochiching	85. Winona
39. Lake of the Woods	86. Wright

2/ This pedon is a taxadjunct to the Anoka series because the base saturation in the argillic horizon is too high and the B2 horizon is too thin for the series range.

3/ This pedon, now placed in the Brainerd series, is an Aquic Fragiochrept; coarse-loamy, mixed, frigid. The Nokay series is classified Aeric Fragiaqualf; coarse-loamy, mixed, frigid.

4/ This pedon is a taxadjunct because it lacks low chroma mottles in the Brainerd series.

5/ This pedon is changed to the Canisteo series from Webster because it is calcareous in the control section.

6/ This pedon is changed to the Canisteo series from Webster because it is calcareous in the control section.

7/ This pedon is changed to the Cordova series from Webster because it has an argillic horizon.

8/ This pedon is a taxadjunct because it has less clay in the argillic horizon and less albic material in the B1 horizon than that required for the Erin series.

9/ This pedon is a taxadjunct because it has a B/A clay ratio which is too high for the Flak series. This pedon is not part of the Brainerd series (Aquic Fragiochrepts) because it is a Typic Fragiboralf.

10/ This pedon is a taxadjunct because it has a B/A clay ratio which is too high and has too much clay in the B2 horizon for the Flak series.

11/ This pedon is a taxadjunct to the Hayden series because there is interfingering of albic material into the argillic horizon.

12/ This pedon is included with the Hattie series; Synnes has never been correlated as a series name.

13/ This pedon is a taxadjunct because it has chroma in the lower part of the A and upper part of the B horizons that is too high for the Nokay series.

14/ This pedon, now placed in the Nymore series, is a Typic Udipsamment. The Hubbard series is classified Udorthentic Haploborall; sandy, mixed.

15/ This pedon is changed to the Sartell series from the Nymore because the dominant sand size particles in the control section are finer than those found in the Nymore series.

16/ This pedon, now placed in the Sartell series, is a Typic Udpsamment.

19/ This pedon is not placed in a named series because it is a Mollic Ochraqualf; fine, montmorillonitic, mesic. The Lerdal series is classified Udollic Ochraqualf; fine, montmorillonitic, mesic.

20/ This pedon is not placed in a named series because it is an Aquollic Hapludalf; fine, montmorillonitic, mesic. The Lerdal series is classified Udollic Ochraqualf; fine, montmorillonitic, mesic.

21/ This pedon is not placed in a named series; it is a Typic Udipsamment; mixed, frigid. Swatara has never been correlated as a series name.

22/ This pedon is not placed in a named series because it is a Typic Haplaquept; fine, montmorillonitic, nonacid, frigid. The Wildwood series is classified Histic Humaquept; very-fine, montmorillonitic, nonacid, frigid.

SOIL CLASSIFICATION-

SERIES - - - - - - - -

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, MRTSC
SOIL SURVEY INVESTIGATIONS UNIT
LINCOLN, NEBRASKA

SOIL NO- - - - - - -

COUNTY - - -

GENERAL METHODS- - -

SAMPLE NOS.-

DEPTH HORIZON (- - - - - - - - - - - - - -PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B- - - - - - - - - -)RATIO

		FINE (- - - - - SAND - - - - - -)(- - -SILT- - - -)												FRAG	INTR	FINE	NON-	8D1
	SAND	SILT	CLAY	CLAY	VCOS	CORS	MEDS	FNES	VFNS	COSI	FNSI	VFSI	TEXT	II	CLAY	CO3-	15-
	2	05	17	12	2	7	6	26	14	05	02	005	SAND	7	70	CLAY	BAR

IN .05 .002 .002 .0002 1 .5 .25 .10 .05 .02 .002 .002 2-.1 .02 CLAY TO
(- - - - - - - - - - - - - - - - - - PCT LT 2MM - - - - - - - - - - - - - - - - - -) PCT PCT CLAY

Depth (in.)	Horizon	Size class and particle diameter (mm)																
		Total				Sand					Silt							
		Sand (2-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Fine clay (<0.0002)	Very coarse (2-1)	Coarse (1-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)	(0.05-0.02)	Int. III (0.02-0.002)	(0.005-0.002)	Family texture sand (2-0.1	International II (0.2	Ratio fine clay to clay	Non-carbonate clay pct	Ratio 15-bar to clay
		Pct of < 2mm																
COLUMN																		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

DEPTH (PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2)(BULK DENSITY)(- - - -WATER CONTENT- - - -) CARBONATE (- -PH - -)

	VOL. (- - - - - - - WEIGHT - - - - - - -)						4A1D	4A1H	4D1	4B1C	4B1C	4B2	4C1	6E1B	3A1A	8C1A	8C1E
	GT 2	GT 75	75-20	20-5	5-2	LT .074	20-2	1/3- OVEN	COLE	1/10	1/3-	15-	WRD	LT 2	LT .002	1/1	1/2
IN	PCT	PCT	(- - - PCT LT 75 - - -)			PCT	LT20	G/CC	G/CC	BAR PCT	BAR PCT	BAR PCT	CM/ CM	PCT	PCT	H2O	CACL

Depth (in.)	Size class and particle diameter (mm)						Bulk density			Water content				Carbonate as $CaCO_3$		pH	
	Volume	Weight					1/3-bar	Oven-dry	COLE	1/10-bar	1/3-bar	15-bar	1/3- to 15-bar	< 2mm	<0.002 mm	(1:1) H_2O	(1:2) $CaCl_2$
	> 2	> 75	75-20	20-5	5-2	<0.074 Pass 200 mesh							cm/cm (in./in.)				
	pct	pct	pct < 75mm				g/cc	g/cc		pct	pct	pct		pct	pct		
COLUMN																	
1	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38

DEPTH (ORGANIC MATTER) IRON PHOS (- -EXTRACTABLE BASES 5B4A- -) ACTY AL (CAT EXCH) RATIO RATIO CA (BASE SAT)

	6A1A	6B1A	C/N	6C2A	6S1A	6N2E	6Q2D	6P2A	6Q2A		6H1A	6G1D	5A3A	5A6A	8D1	8D3	5F	5C3	5C1
	ORGN CARB	NITG		EXT FE	TOTL	CA	MG	NA	K	SUM EXTB	BACL TEA	KCL EXT	EXTB ACTY	NHAC	NHAC TO	CA TO	SAT NHAC	EXTB ACTY	NHAC
IN	PCT	PCT		PCT	PCT	(- - - - - - - - - - - -MEQ / 100 G- - - - - - - - - - -)									CLAY	MG	PCT	PCT	PCT

Depth (in.)	Organic matter			Ext. iron as Fe	Total phosphorus	Extractable bases 5B					Ext. acidity	KCl ext. Al	Cat.exch.cap.		Ratio NH_4OAc to clay	Ratio Ca to Mg	Ca saturation NH_4OAc	Base saturation	
	Organic carbon	Nitrogen	C/N			Ca	Mg	Na	K	Sum extractable bases			Sum of bases plus acidity	NH_4OAc				Extractable acidity	NH_4OAc CEC
	pct	pct		pct	pct	meq/100g											pct	pct	pct
COLUMN																			
1	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57

DEPTH (SATURATED PASTE) NA NA SALT GYP (- - - - - - - - - SATURATION EXTRACT 8A1- - - - - - - - - -) ATTERBERG

	8E1 REST OHM-	8C1B	8A	5D2	5E	8D5 TOTL SOLU	6F1A	8A1A EC	6N1B	6O1B	6P1A	6Q1A	6I1A	6J1A	6K1A	6L1A	6M1A	4F1	4F2
		PH	H2O	ESP	SAR			MMHOS/	CA	MG	NA	K	CO3	HCO3	CL	SO4	NO3	LQID LMIT	PLST INDX
IN	CM		PCT	PCT		PPM	PCT	CM	(- - - - - - - - - - MEQ / LITER - - - - - - - - - -)									PCT	

Depth (in.)	Saturated paste			Exch. Na	Sodium adsorption ratio	Total soluble salt	Gypsum	Saturation extract										Atterberg	
	Resistivity	pH	Water at sat.					Electrical conductivity	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	Liquid limit	Plastic index
	ohm-cm		pct	pct		ppm	pct	mmhos/cm	meq/liter									pct	
COLUMN																			
1	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76

Remarks: EXAMPLE DATA SHEET HEADINGS--This page alternates computer data sheet headings with printed data sheet headings and column numbers. Column numbers refer to more complete column headings on an adjoining page.

COLUMN HEADINGS FOR COMPUTER PRINTED DATA SHEETS

Column	
1	Depth in centimeters
2	Horizon
	Columns 3 through 16 display numbers which are percents of the total weight of particles 2 millimeters or less in size.
3	Total sand (particles range from .05 to 2 millimeters)
4	Total silt (particles range from .002 to .05 millimeter)
5	Total clay (particles are smaller than .002 millimeter)
6	Total fine clay (particles are smaller than .0002 millimeter)
7	Very coarse sand (particles range from 1 to 2 millimeters)
8	Coarse sand (particles range from 0.5 to 1 millimeter)
9	Medium sand (particles range from 0.25 to 0.5 millimeter)
10	Fine sand (particles range from 0.1 to 0.25 millimeter)
11	Very fine sand (particles range from .05 to 0.1 millimeter)
12	Coarse silt (particles range from .02 to .05 millimeter)
13	Fine silt (particles range from .002 to .02 millimeter; these limits also define the range of total silt on the International Soil Science Society Scale.)
14	Very fine silt (particles range from .002 to .005 millimeter)
15	Family texture sand (particles range from 0.1 to 2 millimeters)
16	International II (particles range from .02 to 0.2 millimeter; these limits define the range of the fine sand on the International Soil Science Society Scale.)
17	Fine clay to clay (this is the ratio of fine clay to total clay expressed as percent.)
18	Noncarbonate clay (this is the percentage of total clay, column 5, minus the percentage of carbonate clay, column 36.)
19	Ratio of 15-bar water percentage to total clay percentage
20	Volume of material greater than 2 millimeters given as a percent of total (sample volume)
21	Greater than 75 millimeter material given as a percent of total sample weight
22	Particle size range from 20 to 75 millimeters given as a weight percent of all material 75 millimeters or less in the sample
23	Particle size range from 5 to 20 millimeters given as a weight percent of all material 75 millimeters or less in the sample
24	Particle size range from 2 to 5 millimeters given as a weight percent of all material 75 millimeters or less in the sample
25	Particle size range less than 0.74 millimeter given as a weight percent of all material 75 millimeters or less
26	Particle size range from 2 to 20 millimeters given as a weight percent of all material 20 millimeters or less
27	Bulk density of soil desorbed to 1/3-bar given in grams per cubic centimeter
28	Bulk density of oven dry soil given in grams per cubic centimeter
29	Coefficient of linear extensibility
30	Water content of soil desorbed to 1/10-bar given as a percent of oven dry weight
31	Water content of soil desorbed to 1/3-bar given as a percent of oven dry weight
32	Water content of soil fragments desorbed to 15 bars given as a percent of oven dry weight
33	Water retention difference given in centimeter per centimeter
34	Column used for any water content measurement different from those given in columns 30 through 33
35	Carbonate content of the material 2 millimeters or less given as a percent
36	Carbonate content of the material .002 millimeter or less given as a percent
37	pH of a 1:1 suspension of soil in distilled water
38	pH of a 1:2 suspension of soil in .01 M $CaCl_2$
39	Organic carbon given as a percent
40	Nitrogen given as a percent
41	Organic carbon to nitrogen ratio
42	Extractable iron given as a percent
43	Total phosphorus given as a percent
44	Extractable calcium given in milliequivalents per 100 grams of soil
45	Extractable magnesium given in milliequivalents per 100 grams of soil
46	Extractable sodium given in milliequivalents per 100 grams of soil
47	Extractable potassium given in milliequivalents per 100 grams of soil
48	Sum of the extractable bases given in milliequivalents per 100 grams of soil
49	Acidity - barium chloride with triethanolamine measurement - given in milliequivalents per 100 grams of soil
50	Aluminum - potassium chloride extraction - given in milliequivalents per 100 grams of soil
51	Cation exchange capacity by sum of the extractable bases plus the acidity given in milliequivalents per 100 grams of soil
52	Cation exchange capacity as measured by ammonium acetate given in milliequivalents per 100 grams of soil
53	Ratio of ammonium acetate cation exchange capacity to total clay
54	Ratio of extractable calcium to extractable magnesium
55	Calcium saturation of the ammonium acetate cation exchange capacity given as a percent
56	Base saturation - sum of the extractable bases divided by the acidity plus the sum of the extractable bases - given as a percent

Continued

COLUMN HEADINGS FOR COMPUTER PRINTED DATA SHEETS

Column	
57	Base saturation - sum of the extractable bases divided by the ammonium acetate cation exchange capacity - given as a percent
58	Saturated paste (soil plus water) resistivity given in ohm-cm
59	Saturated paste (soil plus water) pH
60	Saturated paste (soil plus water) water content given as a percent
61	Exchangeable sodium percentage
62	Sodium adsorption ratio
63	Total soluble salt given in parts per million
64	Gypsum given in percent
65	Electrical conductivity of the saturation extract given in mmhos per centimeter
66	Calcium content of the saturation extract given in milliequivalents per liter
67	Magnesium content of the saturation extract given in milliequivalents per liter
68	Sodium content of the saturation extract given in milliequivalents per liter
[illegible]	[illegible]

SOIL CLASSIFICATION-TYPIC FRAGIBORALF
COARSE-LOAMY, MIXED, FRIGID
SERIES - - - - - - - AHMEEK TAXADJUNCT

SOIL NO - - - - - - S68MN-9-2 COUNTY - - - CARLTON

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 68L1193-68L1201

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, MTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

FEBRUARY 1977

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B															RATIO
		SAND 2- .05	SILT .05- .002	CLAY LT .002	FINE CLAY LT .0002	SAND VCOS 2- 1	SAND CORS 1- .5	SAND MEDS .5- .25	SAND FNES .25- .10	SAND VFNS .10- .05	SILT- CCSI .05 .02	SILT- FNSI .02 .002	SILT- VFSI .005- .002	FAML TEXT SAND 2-.1	INTR II .2- .02	FINE CLAY TO CLAY	NON- CO3- CLAY	8D1 15- BAR TC
CM		PCT LT 2MM														PCT	PCT	CLAY
C0C-5	A1	41.8	50.1	8.1		.9	4.0	8.3	18.0	10.7	26.0	24.1	5.8	31.1	46.1			1.3
C05-8	A2	41.1	52.1	6.8		2.2	4.5	7.2	16.7	10.5	26.8	25.3		30.6	45.9			.66
C08-13	B21HIR	43.2	50.3	6.5		2.7	4.4	7.5	17.1	11.5	28.0	22.3		31.7	48.5			.86
C13-23	B22HIR	46.0	47.4	6.6		3.1	4.6	8.0	16.8	13.5	25.5	21.8	5.4	32.4	47.9			.71
C23-41	B23HIR	51.0	43.6	5.4		2.7	5.7	9.1	20.8	12.7	23.5	20.1		38.3	47.0			.54
C41-66	B'1TX	55.5	37.8	6.7		3.8	7.1	9.5	22.2	12.9	19.0	18.8		42.6	43.8			.48

DEPTH	(PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2) VOL. GT 2	GT 75	75-20	20-5	5-2	.074	2C-2	BULK DENSITY 4A1D 1/3- BAR	4A1H OVEN DRY	4D1 COLE	4B1C 1/10 BAR	WATER CONTENT- 4B1C 1/3- BAR	4B2 15- BAR	4C1 WRD	CARBONATE 6E1B LT 2	3A1A LT .002	PH 8C1A 1/1 H2O	8C1E 1/2 CACL
CM	PCT	PCT	WEIGHT PCT LT 75			LT 2	PCT LT 2	G/CC	G/CC		PCT	PCT	PCT	CM/ CM	PCT	PCT		
C0C-5	TR	0	0	TR	TR	64	TR						10.6				5.1	4.4
C05-8	3	0	0	3	1	62	4						4.5				4.8	4.0
C08-13	5	0	TR	6	TR	60	6						5.6				5.0	4.3
C13-23	5	0	TR	5	4	57	9	1.36	1.39	.007	21.5		4.7	.22			5.2	4.3
C23-41	5	0	TR	4	2	53	6	1.49	1.50	.002	17.2		2.9	.20			5.4	4.4
C41-66	10	0	5	5	5	45	15	1.83	1.85	.003	12.6		3.2	.15			5.6	4.6
C66-91	10	0	5	5	5	45	10	1.87	1.94	.011		13.2	4.9	.14			6.0	5.2
C91-114	10	0	5	5	TR	50	7	1.85	1.92	.012		14.0	5.3	.15			6.5	5.7
114-152	10	0	5	5	5	50	10	1.78	1.85	.012		17.0	6.7	.17			6.7	5.9

Pedon classification: Typic Fragiboralf; coarse-loamy, mixed, frigid.
Series classification: Typic Fragiochrepts; coarse-loamy, mixed, frigid.
Soil: Ahmeek taxadjunct.
Soil No.: S68 MN-9-2.
Location: Carlton County, Minnesota; NW1/4, NE1/4, SW1/4, Sec. 34, T. 49 N., R. 20 W.; 1,050 feet west and 180 feet south of the center of the section. About 92 deg. 52 min. west longitude and 46 deg. 41 min. north latitude.
Climate: Humid continental. Some characteristics of temperature in deg. F. are: annual normal - 40, winter normal - 12, summer normal - 65; some characteristics of precipitation in inches are mean

[redacted]

with local relief of mostly 20 to 30 feet.
Landscape setting: Site has a 3 percent convex southeast facing slope near the crest of a knoll. Local relief in the immediate vicinity of the site is about 10 feet and this site is on the higher part of the terrain. Soils of the Nora series, organic soils, and soils of this series are dominant in the immediate vicinity. Elevation is about 1,320 feet.
Vegetation: Deciduous-coniferous forest with mostly paper birch and maples with some small balsam fir; understory is chiefly hazel with some juneberries.
Drainage: Well drained.
Erosion: None.
Moisture: Moist to about 90 cm, below that only slightly moist.
Ground water: Deeper than 185 cm.
Permeability: Moderate in upper part and moderately slow in lower part.
Described by: R. Lewis and H. R. Finney on October 7, 1968.
Sampled by: L. Shields, G. Holmgren, R. Rust, and P. Nyberg on October 7, 1968.

O 1 to 0 cm (1/2 to 0 inches). A mixture of decomposed and partly decomposed plant material.

[redacted] 0 to 5 cm (0 to 2 inches). Very dark brown (10YR 2/2) fine sandy loam; moderate

SOIL CLASSIFICATION-TYPIC CALCIAQUOLL
COARSE-LOAMY, OVER SANDY OR SANDY SKELETAL, FRIGID
SERIES - - - - - - -ARVESON TAXADJUNCT

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, NTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

SOIL NO - - - - - - S67MN-54-1 COUNTY - - - NORMAN

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 67L556-67L564 FEBRUARY 1977

DEPTH CM	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B (PCT) SAND 2- .05	SILT .05- .002	CLAY LT .002	FINE CLAY LT .0002	VCOS 2- 1	CORS 1- .5	MEOS .5- .25	FNES .25- .10	VFNS .10- .05	COSI .05 .02	FNSI .02 .002	VFSI .005- .002	FAML TEXT SAND 2-.1	INTR TI .2- .02	FINE CLAY TO CLAY	NON- CO3- CLAY PCT	8D1 15- BAR TO CLAY PCT	RATIO
COC-15	A11	23.3	37.0	39.7		.5	2.0	3.2	11.0	6.6	11.6	25.4		16.7	25.1		21	.75	
C15-25	A12	41.6	25.2	33.2		1.1	3.4	5.8	24.1	7.2	5.3	19.9		34.4	27.7		10	.45	
C25-36	A3CA	51.0	22.5	26.5		.4	4.0	7.0	30.0	9.6	4.7	17.8		41.4	33.3		9	.36	
C36-64	C1GCA	79.7	10.8	9.5		2.2	4.8	8.8	46.8	17.4	4.1	6.7		62.3	52.4		6	.34	
C64-74	C2GCA	85.8	7.9	6.3		.1	2.9	10.9	54.9	17.C	3.6	4.3		68.8	55.0		6	.41	
C74-97	C3G	94.4	3.7	1.9		.0	1.4	6.9	68.6	17.5	1.4	2.3		76.9	67.0		2		
C97-114	C4G																		
114-147	C5G	93.9	3.2	2.9		.9	1.6	2.4	75.6	13.3	2.C	1.2		80.5	77.3		3		
147-173	C6G																		

DEPTH CM	(PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2) VOL. GT 2 PCT	WEIGHT GT 75 PCT	75-20	20-5	5-2	LT .C74	20-2 PCT LT20	(BULK DENSITY) 4A1D 1/3- BAR G/CC	4A1H OVEN DRY G/CC	4D1 COLE	(WATER CONTENT) 4B1C 1/10 BAR PCT	4B1C 1/3- BAR PCT	4B2 15- BAR PCT	4C1 WRD CM/ CM	CARBONATE 6E1B LT 2 PCT	3A1A LT .002 PCT	(PH) 8C1A 1/1 H2O	8C1E 1/2 CACL
000-15	TR	0	0	0	TR	8C	TR	.57	.86	.150		103.0	29.7	.42	37	19	7.8		
C15-25	TR	0	0	0	TR	6C	TR	.60	.87	.130		97.2	15.0	.49	44	23	7.9		
C25-36	TR	C	0	C	TR	52	TR	1.28	1.33	.013		23.2	9.5	.18	39	18	8.0		
C36-64	TR	C	0	TR	TR	26	TR	1.57A	1.57		14.8		3.2	.18	16	4	8.4		
C64-74	TR	C	0	C	TR	18	TR	1.62A	1.64		11.8		2.6	.15	12	TR	8.2		
C74-97	TR	C	0	0	TR	9	TR	1.70B					.5		8	TR	8.4		
C97-114	TR	0	0	TR	TR		TR	1.68A	1.68		11.6		1.1	.18	13		8.2		
114-147	TR	0	0	TR	TR	9	TR						1.3		7	TR	8.0		
147-173	TR	0	0	0	TR		TR						.4		6		8.2		

DEPTH CM	(ORGANIC MATTER) 6A1A ORGN CARB PCT	6B1A NITG PCT	C/N	IRON 6C2A EXT FE PCT	PHOS 6S1A TOTL PCT	(EXTRACTABLE BASES 5B4A) 6N2E CA	6O4C MG	6P2A NA	6Q2A K	SUM	(ACTY) 6H1A BACL TEA	AL 6G1D KCL EXT	(CAT EXCH) 5A3A EXTB ACTY	5A6A NHAC	RATIO 8D2 NHAC TO CLAY	RATIO 8D3 CA TO MG	CA SF SAT NHAC PCT	(BASE SAT) 5C3 EXTB ACTY PCT	5C1 NHAC PCT
										MEQ / 100 G									
COC-15	11.7C	1.08B	11				17.9	.4	.4					41.3	1.97				
C15-25	5.45	.53C	10				5.4	.1	.1					19.4	1.94				
C25-36	1.94	.18B	10				2.6	.1	.1					8.8	.98				
036-64	.22	.02C	11				1.4	.1	.2					3.1	.52				
C64-74	.33																		
C74-97	.C4						.5	.1	.1					1.4					
C97-114	.C4																		
114-147	.C7						.8	.1	.1					2.1					
147-173	.C7						.5	.1	.1					1.2					

DEPTH CM	(SATURATED PASTE) 8E1 REST OHM- CM	8C1B PH	8A H2O PCT	NA 5D2 ESP PCT	NA 5E SAR	SALT 8D5 TOTL SOLL PPM	GYP 6F1A PCT	(SATURATION EXTRACT 8A1) 8A1A EC MMHOS/ CM	6N1B CA	6O1B MG	6P1A NA	6Q1A K	6I1A CO3	6J1A HCO3	6K1A CL	6L1A SO4	6M1A NO3	ATTERBERG 4F1 LQID LMIT PCT	4F2 PLST INDX
									(MEQ / LITER)										
COC-15	660	7.1	137.0			24CC		2.53											
C15-25																			
C25-36	35C0	7.7	43.9			19C		.68											
036-64																			
064-74																			
C74-97																			
C97-114																			
114-147	56CC	7.6	21.9			1CC		.68											
147-173																			

(A) 1/10-BAR, METHOD 4A1G.
(B) ESTIMATED.
(C) 18 KG OF CARBON PER SQ METER TO A DEPTH OF 1 METER, METHOD 6A.

Pedon classification: Typic Calciaquoll; coarse-loamy over sandy or sandy skeletal, frigid.
Series classification: Typic Calciaquolls; coarse-loamy, frigid.
Series: Arveson taxadjunct.
Pedon No.: S67 MN-54-1.
Area: Norman County, Minnesota.
Location: SE¼NW¼SE¼ sec. 27, T. 144 N., R. 45 W. (Lake Ida Twp.); about 150 feet west, southwest of a clump of aspen at that location.
Climate: Some characteristics of temperature in degrees F. are: annual normal - 41, winter normal - 10, summer normal - 68; some characteristics of precipitation in inches are: mean annual - 20, May to September - 14, mean snowfall - 35.
Vegetation: Narrow leaf sedge, prairie cordgrass, redtop, horsetails, and calamagrostis.
Parent material: Calcareous, lacustrine, sandy sediments associated with glacial Lake Agassiz.
Physiography: Glacial Lake Agassiz plain; site occurs immediately west of the McCauleyville beach which is a part of the McCauleyville, Campbell, and Norcross beach-ridge complex.
Topography: Site occurs on about a ½ percent plain slope; it is about 200 yards west of a beach ridge which rises some 15 feet higher than the sampling site.
Drainage: Poorly to very poorly drained.
Ground water: At 54 inches.
Erosion: None.
Permeability: Moderate in upper part, rapid in lower part.
Moisture: Moist throughout.
Sampled by: R. H. Jordan, G. S. Holmgren, D. D. Barron and H. R. Finney on October 16, 1967.

Described by: H. R. Finney.

A11 67L556 0 to 15 cm (0 to 6 inches). Black (N2) silt loam; moderate very fine granular structure; very friable; roots abundant; strongly effervescent; clear smooth boundary.

A12 67L557 15 to 25 cm (6 to 10 inches). Black (10YR 2/1) loam; weak very fine granular structure; very friable; strongly effervescent; clear wavy boundary.

A3ca 67L558 25 to 36 cm (10 to 14 inches). Very dark gray (10YR 3/1) loam; weak very fine subangular blocky structure and weak fine granular structure; very friable; roots plentiful; violently effervescent; about 10 percent inclusions of dark gray (10YR 4/1); abrupt broken boundary.

C1gca 67L559 36 to 64 cm (14 to 25 inches). Gray (2.5Y 5/1) light fine sandy loam; few fine distinct yellowish brown (10YR 5/8) mottles in lower 5 inches of horizon; weak coarse subangular blocky structure; very friable; roots plentiful; violently effervescent; about 5 percent nearly horizontal but discontinuous bands of light brownish gray (2.5Y 6/2), about 1 percent white soft segregations of lime about 2 to 5 mm in diameter; abrupt smooth boundary.

C2gca 67L560 64 to 74 cm (25 to 29 inches). Very dark gray (10YR 3/1) loamy fine sand; few fine faint olive brown (2.5Y 4/4) mottles; massive; very friable; roots few; violently effervescent; horizon averages about 3 inches in thickness and its top varies in depth from 25 to 27 inches; about 1 percent fine, soft dark reddish brown (5YR 3/4) concretions; abrupt smooth boundary.

C3g 67L561 74 to 97 cm (29 to 38 inches). Light brownish gray (2.5Y 6/2) fine sand; few fine distinct yellowish brown (10YR 5/6) mottles; massive in place breaking to single grain; very friable to loose; roots few; slightly effervescent; horizon varies from 4 to 10 inches in thickness; contains a few krotovina; the largest krotovina is about 6 cm across; clear wavy boundary.

C4g 67L562 97 to 114 cm (38 to 45 inches). Light brownish gray (2.5Y 6/2) fine sand; common medium distinct yellowish brown (10YR 5/6) mottles; massive breaking readily to single grain; loose; no roots; slightly effervescent; about 5 percent 1 to 10 mm in diameter soft black and dark grayish brown concretions; about 5 percent dark grayish brown (10YR 4/2) fine sandy loam lenses which are discontinuous and range to about 3 or 4 inches in width and ½ to ¼ inch in thickness generally horizontal but some are vertical; clear wavy boundary.

C5g 67L563 114 to 147 cm (45 to 58 inches). Fine sand; about 50 percent yellowish brown (10YR 5/6) and about 30 percent light brownish gray (2.5Y 6/2) and light olive brown (2.5Y 5/4); common medium and coarse distinct gray (5Y 6/1) mottles, about 5 percent dark gray and very dark gray vertical streaks; massive breaking readily to single grain; loose; no roots; slightly effervescent; clear broken boundary.

C6g 67L564 147 to 173 cm (58 to 68 inches). Light olive gray (5Y 6/2) fine sand; few fine faint light yellowish brown (2.5Y 6/4) mottles; massive breaking readily to single grain; loose; slightly effervescent; the color grades to gray (N6) in the lower part of the horizon; about 10 percent wedge-shaped black (10YR 2/1) inclusions.

Remarks: Colors are for moist soil. Samples were collected from a pit with dimensions of 3 x 10 x 6 feet in depth. This pedon was essentially free of coarse fragments throughout. Colors are for moist soil. Soil temperature at 20 inches was 7.5 degrees C and at 60 inches was 8.5 degrees C. This pedon is very close to the boundary of the sandy and the coarse-loamy over sandy or sandy skeletal family textural classes. Presently this pedon is outside the range of the Arveson series, but it would be considered as a taxadjunct of that series.

SOIL CLASSIFICATION-TYPIC CALCIAQUOLL
COARSE-LOAMY OVER SANDY OR SANDY SKELETAL, FRIGID
SERIES - - - - - - -ARVESON TAXADJUNCT

SOIL NO - - - - - - S67MN-54-2 COUNTY - - - NORMAN

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 67L565-67L576

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, MTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

FEBRUARY 1977

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B															RATIO
					FINE	SAND					SILT			FAML	INTR	FINE	NON-	8D1
		SAND 2- .05	SILT .05- .002	CLAY LT .002	CLAY LT .0002	VCOS 2- 1	CORS 1- .5	MEDS .5- .25	FNES .25- .10	VFNS .10- .05	COSI .05 .02	FNSI .02 .002	VFSI .005- .002	TEXT SAND 2-.1	II .2- .02	CLAY TO CLAY	CO3- CLAY	15- BAR TO
CM		PCT LT 2MM														PCT	PCT	CLAY
C00-18	AF	67.7	13.5	18.8		.2	.9	1.3	37.4	27.9	5.2	8.3		39.8	66.0		13	.57
018-30	B12CA	71.0	11.6	17.4		.2	.8	1.3	43.2	25.5	5.0	6.6		45.5	68.9		8	.49
C3C-41	C1GCA	75.1	10.3	14.6		.2	.6	1.0	45.7	27.5	4.6	5.7		47.6	73.0		7	.40
C41-48	C2GCA	85.5	7.5	7.0		.4	.6	1.0	48.8	34.7	4.2	3.3		50.8	82.7		5	.40
C48-61	C3G	95.1	3.8	1.1		.6	.3	.3	56.7	37.1	3.0	.8		58.0	95.0		1	
C61-84	C4G																	
C84-109	C5G	95.4	4.2	.4		.1	.1	.1	38.7	56.4	3.3	.9		39.0	97.5			
109-132	C6G																	
132-155	C7G																	
155-173	C8G	95.5	3.3	1.2		TR	.1	.3	10.3	84.9	2.9	.4		10.6	97.6			
C3C-46	C1GCA																	
C46-56	C2GCA																	

DEPTH	PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2					BULK DENSITY				WATER CONTENT				CARBONATE		PH	
	VOL.	WEIGHT															
	GT 2	GT 75	75-20	20-5	5-2	LT .074	20-2	4A1D 1/3- OVEN DRY	4A1H OVEN DRY	4D1 COLE	4B1C 1/10 BAR	4B1C 1/3- BAR	4B2 15- BAR	4C1 WRD CM/	6E1B LT 2	3A1A LT .002	8C1A 1/1 H2O	8C1E 1/2 CACL
CM	PCT	PCT				PCT		BAR			BAR	BAR	BAR	CM/				
C00-18	0	0	0	0	0	4C	0	1.25	1.35	.026		33.1	10.7	.28	22	6	8.1	
018-30	TR	C	0	0	TR	36	TR	1.43	1.49	.014		26.6	8.5	.26	11	9	8.1	
C30-41	TR	0	0	0	TR	22	TR	1.46	1.47	.002		16.9	5.8	.16	11	8	8.1	
C41-48	TR	C	0	C	TR	23	TR	1.62A	1.62		14.1		2.8	.18	14	2	8.2	
C48-61	1	C	0	1	1	13	2	1.60B					.3		9	TR	8.3	
C61-84	TR	C	0	TR	TR		TR	1.61A	1.55		15.5		.3	.24	8		8.2	
C84-109	TR	C	0	TR	TR	17	TR	1.59A	1.58		13.7		.3	.21	8	TR	8.2	
109-132	TR	C	0	0	TR		TR						.3		9		8.1	
132-155	2	0	0	1	2		3						.5		12		8.3	
155-173	TR	0	0	0	TR	29	TR						.3		16	TR	8.2	
C30-46	TR	0	0	0	TR		TR						6.7		20		8.1	
C46-56	TR	C	0	0	TR		TR						3.2		13		8.2	

DEPTH	ORGANIC MATTER			IRON	PHOS	EXTRACTABLE BASES 5B4A					ACTY	AL	CAT EXCH	RATIO	RATIO	CA	BASE SAT	
	6A1A ORGN CARB	6B1A NITG	C/N	6C2A EXT FE	6S1A TOTL	6N2E CA	6O4C MG	6P2A NA	6Q2A K	SUM EXTB	6H1A BACL TEA	6G1D KCL EXT	5A3A EXTB ACTY	5A6A NHAC	8D2 NHAC TO CLAY	8D3 CA TO MG	5F SAT NHAC	5C3 EXTB ACTY	5C1 NHAC
CM	PCT	PCT		PCT	PCT	(- - - - - - - - - - -MEQ / 100 G- - - - - - - - - - -)													
C00-18	5.32C						9.6	.2	.1					15.2	1.17				
C18-3C	4.12						4.0	.1	.1					8.5	1.06				
C3C-41	.84						1.8	.1	.1					4.1	.59				
C41-48	.37						1.6	.1	.1					3.1	.62				
C48-61	.07						.4	.1	.1					1.2					
C61-84	.04																		
C84-109	.01																		
109-132	.02																		
132-155	.04																		
155-173	.01						.4	.1	.1					1.3					
C3C-46																			
C46-56																			

(A) 1/10-BAR, METHOD 4A1G.
(B) ESTIMATED.
(C) 21 KG OF CARBON PER SQ METER TO A DEPTH OF 1 METER, METHOD 6A.

Pedon classification: Typic Calciaquoll; coarse-loamy over sandy or sandy skeletal, frigid.
Series classification: Typic Calciaquoll; coarse-loamy, frigid.
Soil: Arveson taxadjunct[17]
Soil No.: S67MN-54-2.
Location: Norman County, Minnesota; NW 1/4, NW 1/4, SE 1/4, Sec. 28, T146N, R45W (Spring Creek Township).
Vegetation: Pasture, mostly redtop and quackgrass.
Climate: Some characteristics of temperature in °F. are: annual normal--41, winter normal--10, summer normal--68; some characteristics of precipitation in inches are: mean annual--20, May to September--14, mean snowfall--35.
Parent material: Calcareous, sandy lacustrine sediments associated with glacial Lake Agassiz.
Physiography: Glacial Lake Agassiz plain; site occurs immediately west of the McCauleyville beach.
Topography: Site occurs on about a 1/4 to 1/2 percent plain, west-facing slope; it is about 180 m west of the beach ridge having Sioux and Renshaw soils. The beach ridge rises about 3 m above the sample site.
Drainage: Poorly to very poorly drained.
Ground water: At 137 cm.
Erosion: None.
Permeability: Moderate in upper part, rapid in lower part.
Moisture: Moist throughout.
Sampled by: R. H. Jordan, G. S. Holmgren, D. D. Barron and H. R. Finney on October 16, 1967.
Described by: H. R. Finney.

A1p 67L565 0 to 18 cm (0 to 7 inches). Black (10YR 2/1) loam grading to silty loam; moderate medium subangular blocky structure breaking to moderate fine granular structure; very friable; roots plentiful; strong effervescence; clear smooth boundary.

A12ca 67L566 18 to 30 cm (7 to 12 inches). Black (10YR 2/1) loam; weak medium subangular blocky breaking readily to weak fine granular structure; very friable; roots plentiful; very strong effervescence; in places this horizon is missing; clear wavy to broken boundary.

C1gca 67L567 30 to 41 cm (12 to 16 inches). Dark gray (2.5Y 4/1) evenly mixed in a coarse pattern with gray (2.5Y 5/1) light fine sandy loam; few fine distinct olive brown (2.5Y 4/4) and few medium and coarse faint olive gray (5Y 5/2) mottles; weakly massive in places breaking readily to weak medium and coarse subangular blocky structure; very friable; few roots; very strong effervescence; clear smooth boundary.

C2gca 67L568 41 to 48 cm (16 to 19 inches). Dark grayish brown (2.5Y 4/2) loamy fine sand; few fine distinct olive brown to dark yellowish brown (2.5Y 4/4 to 10YR 4/4) and a few fine distinct dark brown (7.5YR 3/2) weakly massive in place breaking to weak medium and coarse subangular blocky; very friable; roots few; strong effervescence; abrupt smooth boundary.

C3g 67L569 48 to 61 cm (19 to 24 inches). Light gray (5Y 7/2) fine sand; common medium faint light gray (2.5Y 7/2) and few fine distinct yellowish brown (10YR 5/6) mottles; weakly massive breaking readily to single grains; loose; roots few in the upper part, none in the lower part; in the center of the horizon is about a 1 cm thick strata of very fine gravel (a pebble band); about 1 percent black and dark reddish brown fine soft concretions; noncalcareous; clear wavy boundary.

C4g 67L570 61 to 84 cm (24 to 33 inches). Light brownish gray (2.5Y 6/2) about 55 percent in a coarse pattern with light gray (2.5Y 7/1) about 40 percent fine sand; common fine and medium distinct yellowish brown (10YR 5/6) mottles; weakly massive in place breaking readily to single grain; loose; no roots; noncalcareous; about 2 percent soft fine black concretions; gradual smooth boundary.

C5g 67L571 84 to 109 cm (33 to 43 inches). Light gray (2.5Y 7/2 and 5Y 7/1) fine sand; common coarse faint light brownish gray (2.5Y 6/2 to 5/2) mottles; massive breaking readily to single grains; loose; no roots; noncalcareous; gradual smooth boundary.

C6g 67L572 109 to 132 cm (43 to 52 inches). Grayish brown (2.5Y 5/2) fine sand; many coarse faint gray (5Y 6/1) mottles; weakly massive in place breaking readily to single grains; loose; no roots; slight effervescence; abrupt smooth boundary.

C7g 67L573 132 to 155 cm (52 to 61 inches). This horizon shows marked lamination or stratification; dominant colors are gray (5Y 6/1) and grayish brown (2.5Y 5/2) in layers about 12 mm thick; fine sand; weakly massive in place breaking to single grain; loose; slight effervescence; no roots; horizon also has alternating strata about 3 mm thick of very dark grayish brown fine sand and about 6 mm thick layer of grayish brown heavy loamy fine sand; at the base of the horizon is about a 12 mm thick layer of yellowish brown coarse and very coarse sand with about 10 percent fine and very fine gravel; abrupt smooth boundary.

C8g 67L574 155 to 173 cm (61 to 68 inches). Light brownish gray (2.5Y 6/2) fine sand high in content of very fine sand; single grain; loose; slight effervescence; base color is separated by a thin layer of dark grayish brown (2.5YR 4/2 to 5/2) about 0.5 mm thick; base color occurs as layers about 0.5 to 1 cm in thickness.

Alternate samples

C1gca 67L575 30 to 46 cm (12 to 18 inches). Similar to C1gca at 30 to 41 cm.

C2ga 67L576 46 to 56 cm (18 to 22 inches). Similar to C2gca at 41 to 48 cm.

Remarks: Colors are for moist soil. Sample was obtained from a pit with dimensions of about 1 by 3 by 2 meters in depth. The degree of calcareousness varies horizontally in the pit, so alternate samples were taken at depths of 30 to 46 cm (67L575) and 46 to 56 cm (67L576). These horizons appear to be higher in content of lime. In parts of the pit where the Ca horizon darkens to a color of 2.5Y 4/2. Lamination or stratification are apparent in the lower two horizons, and the lower value colors in zones between the layers results from the higher concentration of dark colored minerals. This pedon represents the coarser textured segment of the series as well as one with a weaker Ca horizon. Soil temperature at 50 cm was 9.5° C. and at 150 cm was 11.5° C.

SOIL CLASSIFICATION- GLOSSIC EUTROBORALF
SERIES - - - - - - - COARSE-LOAMY, MIXED
AUTOMBA SERIES

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, MTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

SOIL NO - - - - - - S68MN-9-9 COUNTY - - - CARLTON

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 68L1211-68L1220 FEBRUARY 1977

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B													RATIO	
					FINE	SAND					SILT			FAML	INTR	FINE
		SAND	SILT	CLAY	CLAY	VCOS	CORS	MEDS	FNES	VFNS	COSI	FNSI	VFSI	TEXT	II	CLAY
		2-	.05-	LT	LT	2-	1-	.5-	.25-	.10-	.05	.02	.005-	SAND	.2-	TO
		.05	.002	.002	.0002	1	.5	.25	.10	.05	.02	.002	.002	2-.1	.02	CLAY
CM		PCT LT 2MM													PCT	PCT
C00-5	A1	36.6	53.1	10.3		1.2	3.9	8.8	15.0	7.6	24.8	28.3		29.0	39.4	
C05-13	B21HIR	38.1	52.5	9.4		1.5	3.7	8.3	16.9	7.7	26.5	26.0		30.4	42.6	
C13-28	B22HIR	45.0	48.2	6.8		2.0	4.9	10.8	18.4	8.8	26.8	21.4		36.1	44.3	
C28-41	B31	68.5	28.3	3.2		3.4	10.4	17.4	26.0	11.3	16.7	11.6		57.2	40.0	
C41-61	B32	62.0	32.9	5.1		3.0	7.8	13.2	25.1	12.5	17.9	15.0		49.1	43.4	
C61-69	B&A	55.6	31.8	12.5		3.2	6.6	11.7	22.2	12.0	16.6	15.2		43.6	40.2	
C69-81	B21T	55.2	30.8	14.0		3.0	6.8	11.0	22.5	11.8	16.1	14.7		43.3	39.6	
C81-102	B22T	51.5	32.3	16.2		2.6	5.4	10.1	21.4	12.1	16.6	15.7		39.4	39.7	
102-117	B3T	52.5	34.7	12.8		2.2	5.7	11.0	21.4	12.2	17.7	17.0		40.2	41.1	
117-152	C	54.7	36.3	9.0		3.0	6.3	10.9	21.7	12.8	18.5	17.8		41.9	42.8	

DEPTH	PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2					BULK DENSITY			WATER CONTENT			CARBONATE		PH	
	VOL.	WEIGHT				4A1D	4A1H	4D1	4B1C	4B1C	4B2	4C1	6E1B	3A1A	8C1A	8C1E
	GT	GT	75-20	20-5	5-2	LT	20-2	1/3-	OVEN	1/10	1/3-	15-	WRD	LT	LT	1/1	1/2
	2	75				.074	PCT	BAR	DRY	COLE	BAR	BAR	BAR	CM/	2	.002	H2O	CACL

C00-5		O	TR	2	TR	66	2					11.6				5.1	4.4
C05-13		O	TR	3	3	62	6					5.8				5.1	4.1
C13-28		O	TR	2	3	57	5					4.0				5.0	4.1
C28-41		O	TR	3	4	34	7					2.4				5.4	4.4
C41-61		O	TR	5	3	41	8					1.7				5.8	4.8
C61-69	5	C	TR	5	3	46	8	1.81	1.89	.014	14.6	5.6	.15			6.2	5.3
C69-81	5	C	TR	6	4	46	10	1.76	1.83	.012	14.0	6.4	.12			6.3	5.4
C81-102	5	C	TR	4	4	50	8	1.72	1.82	.018	15.1	7.1	.13			6.4	5.6
102-117	5	C	TR	4	4	50	8	1.81	1.88	.012	13.6	5.5	.14			6.7	5.7
117-152	5	C	TR	6	4	47	10	1.83	1.89	.010	13.8	4.1	.16			6.8	5.7

DEPTH	ORGANIC MATTER			IRON	PHOS	EXTRACTABLE BASES 5B4A-					ACTY	AL	CAT EXCH		RATIO	RATIO	CA	BASE SAT	
	6A1A	6B1A	C/N	6C2A	6S1A	6N2E	6Q2D	6P2A	6Q2A		6H1A	6G1D	5A3A	5A6A	8D1	8D3	5F	5C3	5C1
	ORGN	NITG		EXT	TOTL	CA	MG	NA	K	SUM	BACL	KCL	EXTB	NHAC	NHAC	CA	SAT	EXTB	NHAC
	CARB			FE						EXTB	TEA	EXT	ACTY		TC	TO	NHAC	ACTY	
CM	PCT	PCT		PCT	UG/G	MEQ / 100 G									CLAY	MG	PCT	PCT	PCT
C00-5	6.17				625A														
C05-13	1.43				100A														
C13-28	.62				215A														
C28-41	.18				137A														
C41-61	.05				105A														
C61-69	.11				115A	4.8	4.2	.1	.1	9.2	4.3		13.5	9.5	.76	1.1	51	68	97
C69-81	.11				170A	5.7	4.9	.1	.1	10.8	4.0		14.8	11.1	.79	1.2	51	73	97
C81-102	.08				210A	7.0	6.1	.1	.1	13.3	4.3		17.6	13.1	.81	1.1	53	76	102
102-117	.06				190A	6.0	5.1	.1	.1	11.3	2.4		13.7	10.8	.84	1.2	56	82	105
117-152	.06				170A														

DEPTH	SATURATED PASTE			NA	NA	SALT	GYP	SATURATION EXTRACT 8A1-									ATTERBERG	
	8E1	8C1B	PH	8A	5D2	8D5	6F1A	8A1A	6N1B	6O1B	6P1A	6Q1A	6I1A	6J1A	6K1A	6L1A	6M1A	4F1	4F2
	REST					TOTL		EC	CA	MG	NA	K	CO3	HCO3	CL	SO4	NO3	LQID	PLST
	OHM-					SOLU		MMHOS/										LMIT	INDX
CM	CM			PCT	PCT	PPM	PCT	CM	MEQ / LITER									PCT	
C00-5																			
C05-13																			
C13-28																			
C28-41																			
C41-61																			
C61-69																			
C69-81																			
C81-102	73C	5.8	21.0			2CC		1.39											
102-117																			
117-152																			

(A) UG/G - PERCHLORIC ACID DIGESTION, AMMONIUM MOLYBDATE AND STANNOUS CHLORICE ACID COLORIMETRY. ANALYSIS BY M. SINGER INSTITUTE OF AGRICULTURE, UNIVERSITY OF MINNESOTA, ST. PAUL, MINNESOTA.

Pedon classification: Glossic Eutroboralf; coarse-loamy, mixed.
Series classification: Same.
Soil: Automba series.
Soil No.: S68 MN-9-9.
Location: Carlton County, Minnesota; SW1/4, SE1/4, SE1/4, Sec. 30, T. 47 N., R. 20 W.; about 900 feet east and 290 feet north of the southeast section corner. About 92 deg. 55 min. west longitude and 46 deg. 31 min. north latitude.
Climate: Humid continental. Some characteristics of temperature in deg. F. are: annual normal - 40, winter normal - 12, summer normal - 65; some characteristics of precipitation in inches are mean annual - 28, May to September - 19, mean snowfall - 55.
Parent material: Reddish brown coarse-loamy till of Automba phase of the Superior Lobe of the Late Wisconsin glaciation.
Physiography: Central lowlands; ground moraine in Brainerd-Automba Drumlin Area (H. E. Wright, 1972).
Landscape setting: Site has a 1 percent convex slope on the summit of a low knoll. Relative relief is about 5 feet. Elevation is about 1,230 feet. Aqualfs and Histosols are the dominant soils in this area.
Vegetation: Deciduous forest; chiefly aspen with a few maples; understory of hazel and grasses; woodlot is pastured.
Drainage: Moderately well drained.
Erosion: None.
Moisture: Saturated to depth of 60 cm; below this it was moist.
Ground water: Water table is perched and flowed into pit at a depth of 30 cm.
Permeability: Moderate.
Described by: R. Lewis and H. Finney on October 11, 1968.
Sampled by: L. Shields and G. Holmgren on October 11, 1968.

A1 68L1211 0 to 5 cm (0 to 2 inches). Black (10YR 2/1) very fine sandy loam; moderate fine granular structure; very friable; abundant mostly fine with some medium and coarse random roots; about 1 percent coarse fragments; clear wavy boundary. (3 to 8 cm thick)

B21hir 68L1212 5 to 13 cm (2 to 5 inches). Dark brown (7.5YR 4/3) very fine sandy loam; moderate fine subangular blocky structure and some fine and very fine granular structure; very friable; [illegible] mostly fine and very fine with some medium and coarse random roots; about 1 percent coarse

B22hir 68L1213 13 to 28 cm (5 to 11 inches). Brown (7.5YR 5/4) fine sandy loam with about 20 percent yellow brown (10YR 5/4) in some parts; few fine faint strong brown mottles; moderate fine subangular blocky structure; very friable; plentiful fine and very fine roots; about 2 percent coarse fragments; clear wavy boundary. (15 to 20 cm thick)

B31 68L1214 28 to 41 cm (11 to 16 inches). Reddish brown (5YR 4/3) grading to (5YR 4/4) sandy loam; few fine faint yellowish red (5YR 4/6) mottles; weak medium platy structure; very friable; few fine and very fine roots; about 10 percent coarse fragments mostly 2 to 10 mm in size; clear wavy boundary. (5 to 13 cm thick)

B32 68L1215 41 to 61 cm (16 to 24 inches). Reddish brown (5YR 4/3) grading to (5YR 4/4) sandy loam; few fine faint yellowish red (5YR 4/6) mottles; weak medium platy structure; very friable; few fine and very fine roots; about 10 percent coarse fragments mostly 2 to 10 mm in size; clear wavy boundary. (5 to 20 cm thick)

B&A 68L1216 61 to 69 cm (24 to 27 inches). Dark reddish brown (5YR 3/3) loam; about 25 percent tongues as much as 20 mm in width in upper part of reddish gray (5YR 5/2) grading to reddish brown (5YR 5/3) A2 material; common fine distinct yellowish red (5YR 4/6) mottles in A2 material and few fine faint dark reddish brown (2.5YR 3/4) mottles in B material; weak coarse prismatic structure parting to weak medium and coarse angular and subangular blocky structure; firm; A2 material ruptures to a friable mass under medium pressure; very few fine and very fine roots; common very fine discontinuous random dendritic tubular pores that are lined with moderately thick clay films in B material; many fine and very fine random dendritic tubular pores in A2 material; about 8 percent coarse fragments ranging from 2 to 5 mm; clear wavy boundary. (8 to 15 cm thick)

B21t 68L1217 69 to 81 cm (27 to 32 inches). Dark reddish brown (5YR 3/3) loam; few faint fine and medium yellowish red (5YR 4/6) mottles; weak coarse prismatic structure parting mostly to weak medium platy and some moderate medium subangular and angular blocky structure; firm, slightly sticky; very few very fine and fine roots mostly on prism faces, no pores; common thin and moderately thick reddish brown (5YR 4/4) clay films on prism faces and common thin clay films on secondary ped faces; about 8 percent coarse fragments mostly 2 to 5 mm; gradual smooth boundary.

B22t 68L1218 81 to 102 cm (32 to 40 inches). Dark reddish brown (5YR 3/3) sandy loam; moderate medium platy structure; firm in place but ruptures under slight pressure to a friable mass; very few fine and very fine roots; very few micro random inped tubular pores; few moderately thick clay films on upper faces of plates and a few thin clay films on lower faces of plates; about 8 percent coarse fragments mostly 2 to 5 mm; gradual smooth boundary.

B3t 68L1219 102 to 117 cm (40 to 46 inches). Dark reddish brown (5YR 3/3) grading to (5YR 3/4)

SOIL CLASSIFICATION-TYPIC ARGIALBOLL
VERY-FINE, MONTMORILLONITIC, MESIC
SERIES - - - - - - -BARBERT TAXADJUNCT

SOIL NO - - - - - - S69MN-7-4 COUNTY - - - BLUE EARTH

GENERAL METHODS- - -1A, 1B1B, 2A1, 2B SAMPLE NOS. 69B784-69B792 (A) JULY 1976
69L905-69L912

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, MTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B (PCT LT 2MM)															RATIO
		SAND 2- .05	SILT .05- .002	CLAY LT .002	FINE CLAY LT .0002	VCOS 2- 1	CORS 1- .5	MEDS .5- .25	FNES .25- .10	VFNS .10- .05	COSI .05 .02	FNSI .02 .002	VFSI .005- .002	FAML TEXT SAND 2-.1	INTR II .2- .02	FINE CLAY TO CLAY	NON- CO3- CLAY	8D1 15- BAR TO CLAY
CM																PCT	PCT	
000-18	AP	5.5	63.5	31.0	12.3	0.2	0.4	0.5	1.4	3.1	17.5	46.0	15.2	2.4	21.5	40		0.48
018-32	A12	5.4	63.0	31.6	12.9	0.2	0.4	0.6	1.5	2.7	17.5	45.5		2.7	21.2	41		0.48
032-45	A2	7.7	58.6	33.7	12.7	0.3	0.7	0.7	1.9	4.1	0.9	57.7	20.7	3.6	4.5	38		0.31
045-54	B21TG	2.6	34.8	62.6	40.0	0.1	0.3	0.4	0.8	1.0	2.7	32.1	14.3	1.6	4.2	64		0.42
054-69	B22TG	1.9	34.9	63.2	38.0	0.0	0.1	0.3	0.6	0.9	3.3	31.6		1.0	4.6	60		0.42
069-104	B23TG	2.3	39.5	58.2	34.8	0.0	0.1	0.4	1.1	0.7	1.1	38.4		1.6	1.4	60		0.46
104-130	B24TG	10.4	45.2	44.4	20.5	0.6	1.3	1.7	4.0	2.9	2.5	42.7	21.8	7.5	7.9	46		0.51
130-191	2B3G	35.6	26.9	37.5	16.5	5.1	6.9	6.2	10.7	6.7	6.5	20.4		28.9	19.4	44		0.54
191-225	2CG	27.4	37.3	35.3	12.0	2.9	3.5	3.7	9.3	8.0	8.9	28.4		19.4	22.7	34		0.56

DEPTH	(PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2) VOL. GT 2 CM	GT 75 PCT	WEIGHT 75-20 PCT	20-5 PCT	5-2 PCT	LT .074 PCT LT 75	20-2 MM LT20	(BULK DENSITY) 4A1D 1/3- BAR G/CC	4A1H OVEN DRY G/CC	4D1 COLE	(WATER CONTENT) 4B1C 1/10 BAR PCT	4B1C 1/3- BAR PCT	4B2 15- BAR PCT	4C1 WRD CM/ CM	CARBONATE 6E1B LT 2 PCT	3A1A LT .002 PCT	(PH) 8C1A 1/1 H2O	8C1E 1/2 CACL
000-18	TR	0	0	0	TR	97		1.19	1.29	.027	32.5	32.5	14.8	.21			5.2	
018-32	TR	0	0	0	TR	97		1.27	1.40	.033	37.1	34.8	15.1	.25			5.2	
032-45	TR	0	0	0	TR	95		1.60	1.62	.004	24.1	23.4	10.6	.20			5.7	
045-54	TR	0	0	0	0	98		1.35	1.79	.099	34.3	33.7	26.2	.10			5.3	
054-69	TR	0	0	0	TR	99		1.17	1.77	.148	46.1	45.3	26.3	.22			5.3	
069-104	TR	0	0	0	TR	98		1.21	1.71	.122	43.7	42.8	26.9	.19			5.3	
104-130	TR	0	0	0	TR	91		1.38	1.60	.051	31.9	30.5	22.8	.11			5.8	
130-191	3	0	2	3	TR	65		1.26	1.51	.064	38.1	36.1	20.3	.20			6.4	
191-225	1	0	1	TR	2	76							19.7		10		7.6	

DEPTH	(ORGANIC MATTER) 6A1A ORGN CARB PCT	6B1A NITG PCT	C/N	IRON 6C2B EXT FE PCT	PHOS 6S1A TOTL PCT	(EXTRACTABLE BASES 5B4A) 6N2E CA	6O2D MG	6P2B NA	6Q2B K	SUM EXTB	ACTY 6H2A BACL TEA MEQ / 100 G	AL 6G1D KCL EXT	(CAT EXCH) 5A3A EXTB NHAC	5A6A NHAC	RATIO 8D1 NHAC TO CLAY	RATIO 8D3 CA TO MG	CA 5F SAT NHAC PCT	(BASE SAT) 5C3 EXTB ACTY PCT	5C1 NHAC PCT
000-18	2.878	0.279	10	0.6		19.5	4.2	0.1	0.7	24.5	8.3		32.8	26.1	0.84	4.6	75	75	94
018-32	2.88	0.270	11	0.7		19.6	4.4	0.1	0.6	24.7	12.2		36.9	26.8	0.85	4.4	73	67	92
032-45	0.81	0.078	10	0.6		11.6	3.6	0.1	0.4	15.7	6.0		21.7	16.3	0.48	3.2	71	72	96
045-54	0.54	0.079	7	1.1		25.6	12.0	0.3	0.8	38.7	10.5		49.2	39.6	0.63	2.1	65	79	98
054-69	0.53			0.9		24.5	12.2	0.3	0.8	37.8	10.3		48.1	38.8	0.61	2.0	63	78	97
069-104	0.54			1.3		23.3	12.4	0.3	0.9	36.9	9.4		46.3	37.6	0.65	1.9	62	80	98
104-130	0.39			1.4		19.8	10.3	0.3	0.8	31.2	5.0		36.2	30.2	0.68	1.9	66	86	103
130-191	0.26			0.9		17.6	8.9	0.4	0.8	27.7	4.8		32.5	25.9	0.67	2.0	68	85	107
191-225	0.26			1.0				0.3	0.6					23.5	0.67				

DEPTH	(SATURATED PASTE) 8E1 REST OHM- CM	8C1B PH	8A H2O PCT	NA 5D2 ESP PCT	NA 5E SAR	SALT 8D5 TOTL SOLU PPM	GYP 6F1A PCT	(SATURATION EXTRACT 8A1) 8A1A EC MMHOS/ CM	6N1B CA	6O1B MG	6P1A NA	6Q1A K	6I1A CO3	6J1A HCO3	6K1A CL	6L1A SO4	6M1A NO3	ATTERBERG 4F1 LQID LMIT PCT	4F2 PLST INDX PCT
CM									MEQ / LITER										
000-18																			
018-32																			
032-45																			
045-54																		80C	45
054-69																			
069-104	2000	5.2																	
104-130	2000	5.6																67C	35
130-191	2000	6.4																	
191-225	2000	7.4																	

ANALYSES BY MINNESOTA AGRICULTURAL EXPERIMENT STATION, ST PAUL, MN. MINERALOGY BY X-RAY ANALYSIS. TOTAL PHOSPHORUS BY NITRIC-PERCHLORIC DIGESTION. AVAILABLE PHOSPHORUS BY BRAY'S NO 1 EXTRACTANT.

DEPTH	(MINERALOGY) MONT	VERM	ILLITE	KAOL	QUARTZ (PCT LT .002MM)	TOTAL P	AVAIL P (--LBS/A--)
000-18	60	0	25	10	5	1506	83
018-32							80
032-45						784	53
045-54	70	0	20	10	0		42
054-69						910	42
069-104							32
104-130	70	0	20	5	5		20
130-191						1292	32
191-225							4

(A) BULK DENSITY AND WATER CONTENT ANALYSES BY THE SOIL SURVEY INVESTIGATIONS UNIT, LINCOLN, NE. UNLESS OTHERWISE INDICATED REMAINING ANALYSES BY THE SOIL SURVEY INVESTIGATIONS UNIT, BELTSVILLE, MD.
(B) ORGANIC CARBON IS 17 SQ TO A DEPTH OF 1 M (6A1).
(C) LL AND PI BY SOIL MECHANICS LAB, USDA-SCS, LINCOLN, NE.

Pedon classification: Typic Argialboll; very-fine, montmorillonitic, mesic.
Series classification: Typic Argialbolls; fine, montmorillonitic, mesic.
Soil: Barbert taxadjunct*
Soil No.: S69 MN-7-4.
Location: Blue Earth County, Minnesota; NW1/4 of NW1/4, Sec. 10, T. 105 N., R. 27 W. (Sterling Twp.); about 360 feet east and 100 feet south of northwest section corner. About 94 deg. 3 min. west longitude and 43 deg. 55 min. north latitude.
Climate: Humid continental. Some characteristics of temperature in deg. F. are: annual normal - 46, winter normal - 17, summer normal - 71; some characteristics of precipitation in inches are: annual normal - 28, May through September - 18, normal snowfall - 40.
Parent material: Deep, moderately fine and fine textured lacustrine sediments over grayish, calcareous, loamy glacial till (New Ulm) of the Des Moines Lobe, Late Wisconsin age.
Physiography: Central lowlands; glacial Lake Minnesota Plain in the Blue Earth Till Plain of H. E. Wright (1972).
Landscape setting: About a 1/2 percent slightly concave slope. General topography is nearly level with a few slight rises and microrelief depressions. Relative relief in the immediate vicinity is about 5 feet, but the site is about 1,000 feet from the Maple River which is incised about 50 feet. Elevation of site is about 1,015 feet. Major associated soils on the landscape near this site are

[redacted]

Vegetation: Recently plowed; native vegetation was tall grass prairie or savanna.
Drainage: Poor to very poorly drained.
Erosion: Slight.
Permeability: Slow.
Described by: R. J. Edwards and H. R. Finney on October 21, 1969.
Sampled by: L. Shields, R. J. Edwards, R. H. Rust, J. J. Murray, J. F. Cummins, and H. R. Finney on October 21, 1969.

Ap 69B784 0 to 18 cm (0 to 7 inches) Very dark gray (10YR 3/1) silt loam; weak very fine subangular blocky structure; friable, slightly plastic and slightly sticky; common roots; abrupt smooth boundary.

A12 69B785 18 to 32 cm (7 to 13 inches) Very dark gray (10YR 3/1) to black (10YR 2/1) silt loam; weak very fine subangular blocky structure; friable, slightly plastic and slightly sticky; common roots; few clean sand and silt particles on faces of peds; clear smooth boundary.

A2 69B786 32 to 45 cm (13 to 18 inches) Dark gray (10YR 4/1) silt loam, gray (10YR 6/1) when dry; common fine faint dark brown (10YR 4/3) and few fine distinct yellowish red (5YR 4/6) mottles; moderate thin platy structure; friable, slightly plastic and slightly sticky; few channel fillings of very dark gray (10YR 3/1); few roots; common vertical open very fine pores; clear smooth boundary.

B21tg 69B787 45 to 54 cm (18 to 21 inches) Very dark gray (5Y 3/1) silty clay or clay; few fine distinct yellowish brown (5YR 4/6) mottles; moderate medium prismatic structure parting to moderate to strong fine and very fine angular blocky structure; very firm, plastic and sticky; common thin and medium black (10YR 2/1) clay films on faces of peds; clear smooth boundary.

B22tg 69B788 54 to 69 cm (21 to 27 inches) Very dark gray (5Y 3/1) dark olive gray (5Y 3/2) clay; moderate medium and coarse prismatic structure parting to moderate to strong fine and very fine angular blocky structure; very firm, plastic and sticky; many medium very dark gray (5Y 3/1) clay films on faces of peds; clear smooth boundary.

B23tg 69B789 69 to 104 cm (27 to 41 inches) Olive gray (5Y 4/2) clay; common fine prominent strong brown (7.5YR 5/6) mottles; weak to moderate medium and coarse prismatic structure parting to moderate to strong fine angular blocky structure; very firm, plastic and sticky; few very dark gray (10YR 3/1) krotovinas; many medium dark olive gray (5Y 3/2) clay films on faces of peds; clear smooth boundary.

B24tg 69B790 104 to 130 cm (41 to 51 inches) Gray (5Y 5/1) silty clay loam; many fine and medium prominent light olive brown (2.5Y 5/4 and 2.5Y 5/6) and grayish brown (2.5Y 5/2) mottles; weak medium and coarse prismatic structure parting to weak fine subangular blocky structure; friable, plastic and sticky; few black (10YR 2/1) clay films in root channels; clear smooth boundary.

IIB3g 69B791 130 to 191 cm (51 to 75 inches) Gray (5Y 5/1) and olive gray (5Y 5/2) clay loam; many medium prominent light olive brown (2.5Y 5/6) mottles; weak fine subangular blocky structure; friable, slightly plastic and sticky; few black (10YR 2/1) clay fillings in pores and root channels; about 5 percent coarse fragments; clear smooth boundary.

Pedon classification: Typic Argialboll; very-fine, montmorillonitic, mesic.
Series classification: Typic Argialbolls; fine, montmorillonitic, mesic.
Soil: Barbert taxadjunct*.
Soil No.: S69MN-7-4.
Location: Blue Earth County, Minnesota; NW1/4 of NW1/4, Sec. 10, T. 105 N., R. 27 W. (Sterling Twp.); about 360 feet east and 100 feet south of northwest section corner. About 94 deg. 3 min. west longitude and 43 deg. 55 min. north latitude.
Climate: Humid continental. Some characteristics of temperature in deg. F. are: annual normal - 46, winter normal - 17, summer normal - 71; some characteristics of precipitation in inches are: annual normal - 28, May through September - 18, normal snowfall - 40.
Parent material; Deep, moderately fine and fine textured lacustrine sediments over grayish, calcareous, loamy glacial till (New Ulm) of the Des Moines Lobe, Late Wisconsin age.
Physiography: Central lowlands; glacial Lake Minnesota Plain in the Blue Earth Till Plain of H. E. Wright (1972).
Landscape setting: About a 1/2 percent slightly concave slope. General topography is nearly level with a few slight rises and microrelief depressions. Relative relief in the immediate vicinity is about 5 feet, but the site is about 1,000 feet from the Maple River which is incised about 50 feet. Elevation of site is about 1,015 feet. Major associated soils on the landscape near this site are of the Baroda, Minnetonka, and Shorewood series.
Vegetation; Recently plowed; native vegetation was tall grass prairie or savanna.
Drainage: Poor to very poorly drained.
Erosion: Slight.
Permeability: Slow.
Described by: R. J. Edwards and H. R. Finney on October 21, 1969.
Sampled by: L. Shields, R. J. Edwards, R. H. Rust, J. J. Murray, J. F. Cummins, and H. R. Finney on October 21, 1969.

Micromorphological studies were made on the A2, B22tg, and IIB3g horizons by Gabriella Carmean under the direction of R. H. Rust. A brief summary of her findings using Brewer's terminology follows:

A2 horizon
The matrix is weakly oriented, and has patches of ferromangans. The fabric is vosepic in a flecked matrix; vertical pores or cracks are specific for this horizon. The skeleton, which forms about 12 percent of the volume, is isolated in the matrix and is mainly quartz and is noncoated with cutans. Voids are mainly small vertical channels and a few meta vughs and are about 19 percent of the volume. The vertical channels do not have argillans; only the vughs and chambers have thick argillans that are visibly oriented. In the matrix there are vertical zones of diffuse ferromangan accumulation. Well formed nodules and glaebules occur also.

B22tg horizon
This was the only sample in which the embedding solution did not impregnate the soil even though all samples were treated the same way. The high content of clay and the small amount of pore space probably is responsible for the low permeability of the sample. The matrix has a vosepic fabric, and was partly washed away in the cutting operations. There is practically no skeleton, the few grains remaining in the sample were coated with thick argillans. The skeleton is only about 4 percent of the volume. The voids form a very intricate pattern of what seems to be skew planes due to the contraction of highly clayey material. Also, a few large vughs and vesicles are present. In total they represent about 14 percent of the volume. The cutans coat all the voids very thickly and they form a very strong combination. They have not been disturbed through the preparation of the thin section but seem to be argillans in deposition and stress cutans in origin.

IIB3g horizon
The fabric has the orientation of the parent material--which is in alteration and decomposition; plasma occurs only in the old voids and cracks. The skeleton is mainly shales and some feldspars and quartz granules. The voids (12 percent) occur more as packing voids between the skeleton particles. About one-third of these voids are chambers and meta vughs. There are no cutans in the voids--only the exterior of the peds and the voids communicating with the exterior are filled with thick cutans.

Conclusions
This pedon seems to be formed from two different parent materials. The upper layer to a depth of 45 cm might be a silty lacustrine deposit; the second layer from 45 to 130 cm might be a clayey lacustrine deposit. Below 130 cm there is glacial till high in skeleton grains.

In the thin sections the A2 and B22tg samples are very different in matrix and much of the clay washed during the sample preparations seems to be clay "in situ." The thick cutans-illuviations observed in the B22tg can be considered as responsible for a higher clay content in the horizon, but not as much as 30 percent difference between this horizon and the A2 horizon.

SOIL CLASSIFICATION-HISTIC HUMAQUEPT
FINE-LOAMY, MIXED, NONACID, FRIGID
SERIES - - - - - - -BLACKHOOF

SOIL NO - - - - - - S68MN-9-3 COUNTY - - - CARLTON

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 68L1179-68L1182

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, MTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

FEBRUARY 1977

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B														RATIO	
		SAND	SILT	CLAY	FINE CLAY	VCOS	CORS	MEDS	FNES	VFNS	COSI	FNSI	VFSI	FAML TEXT	IITR	FINE CLAY	NON-CO3- CLAY
		2-.05	.05-.002	LT .002	LT .0002	2-1	1-.5	.5-.25	.25-.10	.10-.05	.05-.02	.02-.002	.005-.002	SAND 2-.1	.2-.02	TO CLAY	8D1 15-BAR TO CLAY
CM		PCT LT 2MM														PCT	PCT
C33-41	A1	14.0	57.1	28.9	4.0	.4	1.4	3.1	6.2	2.9	12.5	44.6		11.1	18.4	14	.72
C41-48	A2G	38.7	49.0	12.3		1.2	4.2	9.5	16.8	7.0	20.3	28.7		31.7	35.2		.40
C48-79	B1G	48.0	35.2	16.2	6.8	.8	4.4	11.6	22.2	9.0	15.1	20.1		39.0	34.6	42	.41
C79-91	B2	48.1	30.8	21.1		1.2	3.7	11.4	22.5	9.3	12.6	18.2	6.5	38.8	32.7		.42

DEPTH	(PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2) VOL. GT 2	WEIGHT GT 75	75-20	20-5	5-2	LT .074	20-2	BULK DENSITY 4A1D 1/3-BAR	4A1H OVEN DRY	4D1 COLE	WATER CONTENT- 4B1C 1/10 BAR	4B1C 1/3-BAR	4B2 15-BAR	4C1 WRD	CARBONATE 6E1B LT 2	3A1A LT .02	(- -PH - -) 8C1A 1/1 H2O	8C1E 1/2 CACL
CM	PCT	PCT	PCT LT 75				LT20	G/CC	G/CC		PCT	PCT	PCT	CM/CM	PCT	PCT		
C33-41	TR	0	0	TR	TR	88	TR	.94	1.02	.028		63.9	20.8	.41			4.8	3.8
C41-48	TR	0	0	0	TR	65	TR	1.89	1.92	.005		14.4	4.9	.18			5.1	4.1
C48-79	TR	0	0	TR	TR	96	TR	1.91	1.97	.010		14.7	6.7	.15			5.6	4.8
C79-91	TR	0	0	0	TR	56	TR	1.78	1.97	.034		18.2	8.9	.17			6.1	5.5

DEPTH	(ORGANIC MATTER) 6A1A ORGN CARB	6B1A NITG	C/N	IRON 6C2A EXT FE	PHOS 6S1A TOTL	(- -EXTRACTABLE BASES 5B4A- -) 6N2E CA	6Q2D MG	6P2A NA	6Q2A K	SUM	ACTY 6H1A BACL TEA	AL 6G1C KCL EXTR ACTY	(CAT EXCH) 5A3A EXTR	5A6A NHAC	RATIO 8D1 NHAC TO CLAY	RATIO 8D3 CA TO MG	CA SAT NHAC PCT	(BASE SAT) 5F 5C3 EXTB ACTY PCT	5C1 NHAC PCT
CM	PCT	PCT		PCT	UG/G	(- - - - - - - - - - -MEQ / 100 G- - - - - - - - - -)				EXTR	TEA	EXT	ACTY		TO CLAY	MG	PCT	PCT	PCT
C33-41	6.4C	.589	11		1590A														
C41-48	.69	.052	13		215A														
C48-79	.27				350A														
C79-91	.19				395A														

DEPTH	(SATURATED PASTE) 8E1 REST OHM- CM	8C1B PH	8A H2O PCT	NA 5D2 ESP PCT	NA 5E SAR	SALT 8D5 TOTL SOLL PPM	GYP 6F1A PCT	(- - - - - - - - - - SATURATION EXTRACT 8A1- - - - - - - - - -) 8A1A GC MMHOS/CM	6N1B CA	6O1B MG	6P1A NA	6Q1A K	6I1A CO3	6J1A HCO3	6K1A CL	6L1A SO4	6M1A NO3	ATTERBERG 4F1 LQID LMIT PCT	4F2 PLST INDX
CM			PCT	PCT		PPM	PCT	CM	(- - - - - - - - - - MEQ / LITER - - - - - - - - - -)									PCT	
C33-41																		64B	10
C41-48																			
C48-79	6CCC	5.2	23.0			5C		.31										22B	8
C79-91																			

CLAY MINERALOGY (7A2C).
C33-41 VM2 KK2.
C48-79 VM2 KK2.
COMMENTS - BY INFERENCE A LARGE AMORPHOUS COMPONENT IS PRESENT.
RELATIVE AMOUNTS - (X-RAY) 5 = DOMINANT 4 = ABUNDANT 3 = MODERATE 2 = SMALL 1 = TRACE.
MINERAL CODE - KK = KAOLINITE VM = VERMICULITE-MICA.

(A) UG/G - PERCHLORIC ACID DIGESTION, AMMONIUM MOLYBDATE AND STANNOUS CHLORIDE ACID COLORIMETRY. ANALYSIS BY M. SINGER INSTITUTE OF AGRICULTURE, UNIVERSITY OF MINNESOTA, ST. PAUL, MINNESOTA.

(B) LL AND PI BY SOIL MECHANICS LABORATORY, USDA-SCS, LINCOLN, NEBRASKA.

Pedon classification: Histic Humaquept; fine-loamy, mixed, nonacid, frigid.
Series classification: (Same).
Soil: Blackhoof series.

Soil No.: S68MN-9-3
Location: Carlton County, Minnesota; SE¼, NE¼, NE¼, Sec. 34, T. 46 N., R. 19 W.; about 250 feet north of east-west road and 60 feet west of north-south road.

SOIL CLASSIFICATION-TERRIC BOROSAPRIST
LOAMY, MIXED, EUIC
SERIES - - - - - - - -CATHRO

SOIL NO - - - - - - - S72MN-35-4   COUNTY - - - KITTSON

GENERAL METHODS- - -1A,1B1E,2A1,2B   SAMPLE NOS. 72L620-72L623   MARCH 1977

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, MTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

DEPTH CM	HORIZON	SAND 2-.05	SILT .05-.002	CLAY LT .002	FINE CLAY LT .0002	VCOS 2-1	CORS 1-.5	MEDS .5-.25	FNES .25-.10	VFNS .10-.05	COSI .05-.02	FMSI .02-.002	VFSI .005-.002	FAMI TEXT SAND 2-.1	INTR II .2-.02	FINE CLAY TO CLAY PCT	NON-CO3-CLAY PCT	RATIO 8D1 15-BAR TO CLAY
		(- - - PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B				(- - SAND				- -)	(- -SILT		- -)					
		(- - - PCT LT 2MM													- -)			
0-50	OE																	
50-114	OA1																	
114-127	OA2																	
137-152	3CG																	

DEPTH CM	(PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2) VOL. GT 2 PCT	WEIGHT GT 75 PCT	75-20 (PCT LT 75)	20-5	5-2	LT .074	20-2 PCT LT20	(BULK DENSITY) 4A1D 1/3-BAR G/CC	4A1H OVEN DRY G/CC	4D1 COLE	(WATER CONTENT) 4B1C 1/10 BAR PCT	4B1C 1/3-BAR PCT	4B2A 15-BAR PCT	4C1 WRD CM/CM	CARBONATE 6E1B LT 2 PCT	3A1A LT .002 PCT	(PH) 8C1A 1/1 H2O	8C1E 1/2 CACL
0-50								.12	.26	.29	615	520	81	.51				
50-114								.22	.44	.25	379	359	87	.61				
114-127								.28	.55	.26	313	284	59	.56				
137-152													6					

DEPTH CM	(ORGANIC MATTER) 6A1A ORGN CARB PCT	6B1A NITG PCT	C/N	IRON 6C2B EXT FE PCT	PHOS TOTL PCT	(EXTRACTABLE BASES 5B4A) 6N2E CA	6O2D MG	6P2B NA	6Q2B K	SUM EXTB	ACTY 6H1A BACL TEA	AL 6G1E KCL EXT	(CAT EXCH) 5A3B EXTB ACTY	5A6A NHAC	RATIO 8D1 NHAC TO CLAY	RATIO 8D3 CA TO MG	CA 5F1 SAT NHAC PCT	(BASE SAT) 5C3 EXTB ACTY PCT	5C1 NHAC PCT
						(- - - MEQ / 100 G								- -)					
0-50	48.9					157	76.3	1.8	.2	235	45.2		280	117.0		2.1	134	84	201
50-114	49.5					131	55.2	1.0	.2	187	53.6		241	147.0		2.4	89	78	127
114-127						115	45.8	.7	.4	162	57.5		219	135.0		2.5	85	74	120
137-152														4.8					

DEPTH CM	(SATURATED PASTE) 8E1 REST OHM-CM	8C1B PH	8A H2O PCT	NA 5D2 ESP PCT	NA 5E SAR	SALT 8D5 TOTL SOLU PPM	GYP 6F1A PCT	(SATURATION EXTRACT 8A1) 8A1A EC MMHOS/CM	6N1B CA	6O1B MG	6P1B NA	6Q1B K	6I1A CO3	6J1A HCO3	6K1A CL	6L1A SO4	6M1A NO3	ATTERBERG 4F1 LQID LMIT PCT	4F2 PLST INDX
									(- - - MEQ / LITER								- -)		
0-50	520	5.3	598			18300		4.24	28.5	42.5	1.1	.1	0	1.1	.2	62.8	5.5		
50-114	650	5.3	705			14900		3.03	27.8	21.8	.8	.1	0	.2	.0	44.9	2.5		
114-127	920	5.4	596			8400		2.08	16.0	12.5	.4	.2	0	.7	.0	26.4	1.8		
137-152																			

DEPTH CM	(HISTOSOL CHARACTERIZATION) 8F MINL CONT PCT	(STATE OF DECOMPOSITION) 8G (FIBER VOL) UNRB PCT	8G RUB PCT	8H PYROPHOSPHT SOLUBILITY	PH 8C1E .01M CACL	(BULK DEN) 4A3A FILD STAT G/CC	4A1I 1/3B REWT G/CC	COLE 4D1 RE-WET	SUBS RES-IDUE PCT	(WATER CONTENT) 4B4 FILD STAT PCT	4B1C 1/3B REWT PCT	4B2 15-BAR PCT	4C1 WRD CM/CM
0-50	16	53	20	10YR 6/3	5.5	.18			70A	340		81	
50-114	19	33	5	7.5YR 5/4	5.4	.24			100	396		83	
114-127	32	23	3	7.5YR 3/2	5.7	.31			94	272		73	
137-152												5	

(A) COMPUTED AS HALF SURFACE AND HALF SUBSURFACE.

Pedon classification: Terric Borosaprist; loamy, mixed, euic.
Series classification: Same.
Soil: Cathro series

Location: Kittson County, Minnesota; SW ¼, SE ¼, Sec. 23, T. 161 N., R. 45 W. About 48.7 deg. north latitude and about 97.5 deg. west longitude.
Climate: Humid continental. Mean annual temperature is 38 deg. F.; mean summer temperature is 66 deg. F., and mean winter temperature is 6 deg. F. Mean annual precipitation is 20 inches; mean May through September precipitation is 14 inches; total annual snowfall is about 35 inches. Frost-free period is about 110 days.
Parent material: Organic soil material that is derived primarily from herbaceous plants over loamy glacial till of the DesMoines lobe of the Late Wisconsin glaciation.
Physiography: Central lowlands; Lake Agassiz Plain; area is nearly level and local relief is mostly less than 5 feet. Elevation is about 1,015 feet.
Vegetation: Mostly sedges and grasses with some equisetum, mint, and willow.
Size of bog: Several thousand acres.
Distance to adjacent mineral land: About 1 mile. Microrelief: Very slight.
Depth to water table: Greater than 150 cm. Subsidence: Slight.
Described and sampled by: D. D. Barron, J. O. Nordin, R. S. Farnham, W. E. McKinzie, W. C. Lynn, and H. R. Finney on July 27, 1972. Samples were obtained from a pit that was dug with a spade.

Oa 721620 0 to 50 cm Very dark brown (10YR 2/2, broken face and rubbed) hemic material, dark brown

SOIL CLASSIFICATION-TERRIC BOROSAPRIST
LOAMY, MIXED, EUIC
SERIES - - - - - - -CATHRO

SOIL NO - - - - - - S72HH-60-1 COUNTY - - - POLK

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, NTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 72L628-72L628 MARCH 1977

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B													RATIO		
		SAND 2- .05	SILT .05- .002	CLAY LT .002	FINE CLAY LT .0002	VCOS 2- 1	COBS 1- .5	MEDS .5- .25	FNES .25- .10	VFNS .10- .05	COSI .05 .02	FNSI .02 .002	VFSI .005- .002	FABL TEXT SAND 2-.1	INTR II .2- .02	FINE CLAY TO CLAY	NON- CO3- CLAY	8D1 15- BAR TO
CM		(- - - - - - - - - - - - - - - - - - PCT LT 2MM - - - - - - - - - - - - - - - - - -)													PCT	PCT	CLAY
0-22	OAP																	
22-50	OE																	
50-104	OA2																	
104-120	2A1B																	
120-135	2CG																	

DEPTH	(PARTICLE SIZE ANALYSIS, 4H, 3B, 3E1, 3B2)					(BULK DENSITY)				(- - - -WATER CONTENT- - - -)				CARBONATE		(- -PH - -)	
	VOL. GT 2	(- - - - - - - WEIGHT - - - - - - -) GT 75	75-20	20-5	5-2	4A1D LT .074	4A1B 20-2 PCT	4D1 1/3- BAR DRY	COLE	4B1C 1/10 BAR	4B1C 1/3- BAR	4B2A 15- BAR	4C1 WRD CM/ CM	6E1B LT 2	3A1A LT .002	8C1A 1/1 H20	8C1B 1/2 CACL
CM	PCT	PCT	(- - - PCT LT 75 - - -)			LT20	G/CC	G/CC		PCT	PCT	PCT		PCT	PCT		
0-22																	
22-50												95					
50-104												89					
104-120												28					
120-135												2					

DEPTH	(ORGANIC MATTER)			IRON	PHOS	(- -EXTRACTABLE BASES 5B4A- -)					ACTY	AL	(CAT EXCH)		RATIO	RATIO	CA	(BASE SAT)		
	6A1A ORGN CARB	6F1A NITG	C/N	6C2B EXT FE	TOTL	6N2B CA	6O2D MG	6P2B NA	6Q2B K	SUM	6H1A BACL TEA	6G1B KCL EXT	5A3A EXTR ACTY	5A6A NHAC	8D1 NHAC TO	8D3 CA TO	5F1 SAT NHAC	5C3 EXTR ACTY	5C1 NHAC
CM	PCT	PCT		PCT	PCT	(- - - - - - - - - - - - MEQ / 100 G- - - - - - - - - - - -)				EXTR					CLAY	MG	PCT	PCT	PCT
0-22																				
22-50	59.0					106.0	34.1	.6	.2	141.0	41.9		183	124.0		3.1	85	77	114	
50-104	55.2					112.0	33.8	.8	.2	147.0	50.2		197	137.0		3.3	82	75	107	
104-120	11.8					33.1	12.7	.3	.2	46.3				44.7		2.6				
120-135	.2					8.0	1.1	.1	.1	9.3				3.8		7.3				

DEPTH	(SATURATED PASTE)			NA		SALT	GYP	(- - - - - - - - - - SATURATION EXTRACT 8A1- - - - - - - - - -)									ATTERBERG		
	8E1 WSAT	8C1B PH	8A H2O	5D2 NSP	5E SAR	8D5 TOTL	6F1A	8A1A EC	6N1B CA	6O1B MG	6P1B NA	6Q1B K	6I1A CO3	6J1A HCO3	6K1A CL	6L1A SO4	6M1A NO3	4F1 LOID	4F2 PLST

CM	ORG- CM	PCT	PCT	SOLU PPM	PCT	MMHOS/ CM	(- - - - - - - - - - MEQ / LITER - - - - - - - - - -)								LMIT INDX PCT
0-22															
22-50	1900	6.1	774	4100		.83	5.3	3.9	.2	TR	0	.2	0	4.4	3.9
50-104	1400	5.6	783	5900		1.16	7.8	5.5	.4	.1	0	.7	0	9.4	3.6
104-120	650	6.8	149	4000		3.73	31.5	25.8	.9	.3	0	1.1	0	54.1	1.8
[illegible]															

DEPTH	(- - - - - - - - - - - - - - - - HISTOSOL CHARACTERIZATION- - - - - - - - - - - - - - - -)													
	(STATE OF DECOMPOSITION)			8F	8G	8H	PH	(BULK DEN)		COLE	SUBS	(- -WATER CONTENT- -)		
	8F RUBB CONT	(FIBER UNRB PCT | VOL) RUB PCT	PYROPHOSPHT SOLUBILITY			8C1B .01M CACL	4A3A FILD STAT G/CC	4A1I 1/3B REWT G/CC	4D1 BF- WET	RES- IDUE PCT	4B4 FILD STAT PCT	4B1C 1/3B REWT PCT	4B2 15- BAR PCT	4C1 WRD CM/ CM
CM	PCT	PCT	PCT												
0-22	25	44	7	7.5YR	5/4	6.0	.26				78	254		95	
22-50	11	57	22	10YR	7/3	5.8	.19				94	356		102	
50-104	47	35	7	10YR	6/3	6.5	.19				91	363		102	
104-120												81		23	
120-135												14		3	

Pedon classification: Terric Borosaprist; loamy, mixed, euic.
Series classification: Same.
Soil: Cathro series.
Soil No.: S72 MN-60-1.
Location: Polk County, Minnesota; about 100 feet east and 100 feet north of junction of east-west drainage ditch and county road in the NW ¼, Sec. 11, T. 151 N., R. 39 W. About 47.8 deg. north latitude and about 95.5 deg. west longitude.
Climate: Humid continental. Mean annual temperature is 39 deg. F.; mean summer temperature is 66 deg. F.; mean winter temperature is 8 deg. F. Mean annual precipitation is 22 inches; mean May through September [illegible] about 15 inches; total annual snowfall is about 45 inches. Frost free period is about 110 days.
Parent material: Organic soil material that is derived primarily from herbaceous plants over loamy lacustrine sediments of glacial Lake Agassiz.
Physiography: Central lowlands; Agassiz Lacustrine Plain. Area is nearly level. Local relief is less than 5 feet. Elevation is about 1,160 feet.
Vegetation: Mostly timothy and quackgrass. **Size of bog:** Several thousand acres.
Distance to adjacent mineral land: About 1 mile. **Microrelief:** None.
Depth to water table: 130 cm. **Subsidence:** Slight.
Described and sampled by: R. S. Farnham, W. E. McKinzie, H. R. Finney, and W. C. Lynn on July 28, 1972. Samples were obtained from a pit that was dug with a spade.

Oap 72L624 0 to 22 cm Black (10YR 2/1, broken face and rubbed) matrix with very dark brown (10YR 2/2, broken face) fiber, sapric material; about 30 percent fiber, about 10 percent rubbed; weak fine crumb structure; very friable; herbaceous fiber; common live roots; about 15 percent mineral material; clear smooth boundary.

Oe 72L625 22 to 50 cm Black (10YR 2/1, broken face and rubbed) matrix with very dark grayish brown (10YR 3/2, broken face) fiber, hemic material; about 75 percent fiber, about 20 percent rubbed; weak thin platy structure; very friable; herbaceous fiber; about 10 percent mineral material; abrupt smooth boundary.

Oa2 72L626 50 to 104 cm Black (N 2/, broken face and rubbed) matrix with very dark brown (10YR 2/2, broken face) fiber, sapric material; about 40 percent fiber, about 5 percent rubbed; weak thin platy structure; very friable; herbaceous fiber; about 20 percent mineral material in upper part increasing to about 40 percent in lower part; abrupt smooth boundary.

IIA1b 72L627 104-120 cm Black (5Y 2/1) loam; weak fine platy structure; very friable; slightly effervescent; clear smooth boundary.

IICg 72L628 120-135 cm Very dark gray (5Y 3/1) in upper part grading to dark gray (5Y 4/1) in lower part, sandy loam; massive; slightly sticky; few pebbles; strongly effervescent.

Remarks: Bulk samples were collected at depths of 0-22, 22-50, 50-104, 104-120, and 120-135 cm. Samples primarily for determination of bulk density were collected at depths of 3-8, 5-15, 12-17, 25-30, 40-45, 45-50, 60-70, 65-70, 90-100, and 95-100 and blocks of known volume were obtained at depths of 0-18, 4-14, 30-51, 36-60, 50-71, and 75-84 cm. Samples primarily for the measurement of fiber were collected at depths of 3-8, 12-17, 25-30, 40-45, 45-50, 65-70, and 95-100 cm.

SOIL CLASSIFICATION-TYPIC DYSTROCHREPT
COARSE-LOAMY OVER SANDY OR SANDY-SKELETAL, MIXED, FRIGID
SERIES - - - - - - -CLOQUET

SOIL NO - - - - - - S68MN-9-6 COUNTY - - - CARLTON

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 68L1144-68L1151

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, MTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

FEBRUARY 1977

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B														RATIO
		SAND 2- .05	SILT .05- .002	CLAY LT .002	FINE CLAY LT .0002	SAND VCOS 2- 1	SAND CORS 1- .5	SAND MEDS .5- .25	SAND FNES .25- .10	SAND VFNS .10- .05	SILT COSI .05 .02	SILT FNSI .02 .002	SILT VFSI .005- .002	FAML TEXT SAND 2-.1	INTR II .2- .02	FINE CLAY TO CLAY	NON- CO3- CLAY	8D1 15- BAR TO CLAY
CM		PCT LT 2MM														PCT	PCT	
000-3	A1	32.7	57.1	10.2		8.9	9.4	6.8	5.2	2.4	28.5	28.6		30.3	32.8			3.05
003-8	A2	39.4	53.9	6.7		6.6	11.9	9.7	7.0	4.2	30.3	23.6		36.2	37.0			.75
008-20	B21HIR	39.1	53.7	7.2		6.5	11.3	10.0	7.0	4.3	31.0	22.7		34.8	37.9			.63
C2C-36	B22HIR	46.0	47.8	6.2		7.6	13.2	12.5	8.2	4.5	28.1	19.7		41.5	35.8			.56
C36-43	2B23T	81.9	12.8	5.3		11.3	29.2	28.9	10.2	2.3	6.9	5.9		79.6	12.4			.74
C43-91	2B3	83.7	10.2	6.1		15.6	32.6	21.8	10.6	3.1	5.4	4.8		80.6	12.4			.66
091-152	2C	97.9	1.8	.3		33.0	48.6	12.8	2.9	.6	1.2	.6		97.3	2.7			
036-43	(A)	58.9	28.0	13.1		10.3	15.9	16.7	11.6	4.3	14.9	13.1		54.6	23.9			.42

DEPTH	PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2 WEIGHT VOL.					BULK DENSITY 4A1O	4A1H	4D1	WATER CONTENT 4B1C	4B1G	4B2	4C1	CARBONATE 6E1B		PH	
	GT 2	GT 75	75-20	20-5	5-2	LT .074	2C-2 1/3- BAR	OVEN DRY	COLE 1/1C BAR	1/3- BAR	15- BAR	WRD CM/ CM	LT 2	LT .002	8C1A 1/1 H2O	8C1E 1/2 CACL
CM	PCT	PCT	PCT LT 75			LT20	G/CC	G/CC		PCT	PCT	PCT	CM	PCT	PCT		
000-3		C	TR	TR	TR	7C	TR				31.1				5.8	5.4
C03-8		C	TR	7	5	55	12				5.0				5.4	4.6
C08-20		C	TR	8	6	55	14				4.5				4.9	4.2
C20-36		TR	15	15	10	35	26				3.5				5.1	4.2
036-43		TR	30	25	5	10	44				3.9				5.5	4.6
043-91		TR	10	10	20	1C	29				4.0				5.5	4.6
091-152		0	TR	7	36	TR	43				1.C				6.2	4.9
036-43				20	14		34				5.5				5.1	4.2

DEPTH	ORGANIC MATTER 6A1A ORGN CARB	6B1A NITG	C/N	IRON 6C2A EXT FE	PHOS 6S1A TOTL	EXTRACTABLE BASES 5B4A- 6N2E CA	6O2O MG	6P2A NA	6Q2A K	SUM EXTB	ACTY 6H1A BACL TEA	AL 6G1O KCL EXT	CAT EXCH 5A3A EXTB ACTY	5A6A NHAC	RATIO 8D1 NHAC TO CLAY	RATIO CA MG	CA 5F SAT NHAC	BASE SAT 5C3 EXTB ACTY	5C1 NHAC
CM	PCT	PCT		PCT	UG/G	MEQ / 100 G											PCT	PCT	PCT
COC-3	16.80	1.CO4	17	.7	360B	44.4	8.2	.1	3.6	56.3	22.5		79.2	62.C	6.08	5.4	72	71	91
C03-8	1.21	.075	16	1.1	155B	2.8	.8	.1	.2	3.9	8.C	.5	11.9	8.3	1.24		34	33	47
008-20	.76	.044	17	1.0	405B	1.0	.3	.1	.3	1.7	9.5	1.7	11.2	7.6	1.06		13	15	22
020-36	.47	.028	17	.8	270B	.9	.2	.1	.2	1.4	8.1	1.7	9.5	5.9	.95		15	15	24
036-43	.3%			.6	9508	2.5	.7	.1	.3	3.6	7.8	.8	11.4	8.0	1.51		31	32	45
043-91	.1%				137B														
091-152	.CE				125B														
036-43	.23				95B														

DEPTH	SATURATED PASTE 8E1 REST OHM-	8C1B PH	8A H2C	NA 5C2 ESP	NA 5E SAR	SALT 8D5 TOTL SOLU	GYP 6F1A	SATURATION EXTRACT 8A1- EC	6N1B CA	6O1B MG	6P1A NA	6Q1A K	6I1A CO3	6J1A HCO3	6K1A CL	6L1A SO4	6M1A NO3	ATTERBERG 4F1 LQID LMIT	4F2 PLST INDX
CM	CM		PCT	PCT		PPM	PCT	MMHOS/ CM	MEQ / LITER									PCT	
000-3																			
003-8																			
008-20																			
020-36	25CCC	4.2	22.7			7C		.46											
C36-43																			
C43-91	17CCC	5.3	20.8			30		.22											
091-152																			
C36-43																			

(A) CLAYEY BAND.
(B) UG/G - PERCHLORIC ACID DIGESTION, AMMONIUM MOLYBDATE AND STANNOUS CHLORIDE ACID COLORIMETRY. ANALYSIS BY M. SINGER INSTITUTE OF AGRICULTURE, UNIVERSITY OF MINNESOTA, ST. PAUL, MINNESOTA.

Soil: Cloquet series
Soil No.: S68MN-9-6
Location: Carlton County, Minnesota; SE1/4, NW1/4, SW1/4, Sec. 16, T. 48 N., R. 18 W.; 120 feet east of northwest-southeast road and 500 feet north of north edge of open cultivated field on east side of road. About 92 deg. 38 min. west longitude and 46 deg. 38 min. north latitude.
Climate: Humid continental. Some characteristics of temperature in deg. F. are: annual normal - 40, winter normal - 12, summer normal - 65; some characteristics of precipitation in inches are: mean annual - 28, May to September - 19, mean snowfall - 55.
Parent material: Noncalcareous outwash consisting of a coarse-loamy mantle over sandy and gravelly sediments of the Nickerson phase of the Superior Lobe of the Late Wisconsin glaciation.
Physiography: Central lowlands; outwash area in Brainerd-Automba Drumlin Area (H. E. Wright, 1972).
Landscape setting: Site has a 4 percent convex, southeast facing slope on the shoulder of an esker or crevass filling. Relative relief is about 50 feet. Soils formed in outwash sediments and organic soils are dominant in the immediate area.
Vegetation: Deciduous-coniferous plant formation; paper birch with few aspen and maples; understory is chiefly hazel with some service berries.
Drainage: Somewhat excessively drained.
Erosion: None.
Ground water: Deeper than 2.0 m.
Permeability: Moderate in upper part and very rapid in lower part.

Moisture: Moist throughout.
Described by: R. Lewis and H. Finney on October 10, 1968.
Sampled by: L. Shields, and G. Holmgren on October 10, 1968.

O 1 to 0 cm (1/2 to 0 inches) Mixture of undecomposed and decomposed plant remains.

A1 68L1144 0 to 3 cm (0 to 1 inches) Black (N 2/) fine sandy loam; weak very fine and fine granular structure; very friable; abundant fine and very fine roots; few fine charcoal fragments; plentiful whitish fungi mycelia; about 3 percent coarse fragments mostly 2 to 10 cm; abrupt wavy boundary. (1 to 8 cm thick)

A2 68L1145 3 to 8 cm (1 to 3 inches) Grayish brown (10YR 5/2) fine sandy loam; moderate fine granular and some moderate very fine subangular blocky structure; very friable; abundant mostly fine and very fine with a few medium and coarse roots; about 3 percent coarse fragments mostly 2 to 10 cm; abrupt wavy boundary. (3 to 8 cm thick)

B21hir 68L1146 8 to 20 cm (3 to 8 inches) Dark brown (7.5YR 4/4) fine sandy loam; moderate very fine subangular blocky structure; very friable; abundant mostly fine and very fine with few medium and coarse roots; about 5 percent coarse fragments mostly 2 to 10 cm; gradual smooth boundary. (8 to 20 cm thick)

B22hir 68L1147 20 to 36 cm (8 to 14 inches) Dark brown (7.5YR 4/4) grading to brown (7.5YR 5/4); fine sandy loam; moderate fine subangular blocky structure; very friable; abundant mostly fine and medium with few medium and coarse roots; about 10 percent coarse fragments mostly 2 to 10 cm; layer of brown (10YR 5/3) albic-like material about 3 cm thick and occupying about 10 percent of

SOIL CLASSIFICATION-TYPIC ARGIAQUOLL
FINE-LOAMY, MIXED, MESIC
SERIES - - - - - - -CORDOVA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, NTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

GENERAL METHODS- - -1A, 1B1B, 2A1, 2B SAMPLE NOS. 69B833-69B839 (A) JULY 1976
69L922-69L929

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B																RATIO
					FINE	SAND						SILT			FAML	INTR	FINE	NON-	8D1
		SAND 2- .05	SILT .05- .002	CLAY LT .002	CLAY LT .0002	VCOS 2- 1	CORS 1- .5	MEDS .5- .25	FNES .25- .10	VFNS .10- .05	COSI .05 .02	FNSI .02 .002	VFSI .005- .002	TEXT SAND 2-.1	II .2- .02	CLAY TO CLAY	CO3- CLAY	15- BAR TO
CM		PCT LT 2MM														PCT	PCT	CLAY
000-23	A1	25.0	39.4	35.6	15.7	1.2	2.7	4.1	9.9	7.1	13.5	25.9	7.2	17.9	26.4	44		0.58
023-33	A3	26.2	36.7	37.1		1.3	3.4	4.5	10.2	6.8	11.2	25.5		19.4	24.1			0.47
033-51	B21T	27.2	36.7	36.1	25.8	1.6	3.1	4.3	10.5	7.7	12.9	23.8	7.8	19.5	26.9	72		0.47
051-68	B22TG	30.9	34.1	35.0	21.0	1.6	3.7	5.0	12.2	8.4	10.8	23.3	7.4	22.5	26.6	60		0.46
068-81	B3TG	37.4	33.8	28.8	13.3	2.2	4.5	6.0	14.9	9.9	10.6	23.2		27.5	29.8	46		0.48
081-102	C1G	38.3	34.7	27.0	9.4	2.5	4.5	5.9	14.8	10.6	12.8	21.9	9.0	27.7	32.5	35		0.48
102-140	C2	30.6	44.5	24.9	9.3	2.3	4.7	6.4	6.0	11.3	20.9	23.6		19.3	32.3	37		0.51
000-20	AP (B)																	
020-30	A3 (B)																	

DEPTH	PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2 VOL.		WEIGHT				BULK DENSITY				WATER CONTENT				CARBONATE		PH	
	GT 2	GT 75	75-20	20-5	5-2	LT .074	20-2	4A1D 1/3- BAR	4A1H OVEN DRY	4D1 COLE	4B1C 1/10 BAR	4B1C 1/3- BAR	4B2 15- BAR	4C1 WRD CM/ CM	6E1B LT 2	3A1A LT .002	8C1A 1/1 H2O	8C1E 1/2 CACL
CM	PCT	PCT	PCT LT 75				LT20	G/CC	G/CC		PCT	PCT	PCT		PCT	PCT		
000-23	TR	0	0	0	TR	79		0.89	1.20	0.105	55.3	55.3	20.8	0.31	2.5D		6.8	
023-33	TR	0	0	TR	1	77		1.20C					17.4				6.4	
033-51	TR	0	0	TR	1	76		1.33	1.71	0.086	32.0	30.4	17.0	0.18			6.4	
051-68	TR	0	0	1	1	73		1.34	1.75	0.092	32.3	30.5	16.1	0.19		1	7.0	
068-81	2	0	0	1	3	66		1.35	1.64	0.066	31.8	29.8	13.7	0.21		14	7.7	
081-102	3	0	0	2	4	65		1.39	1.58	0.043	28.9	26.5	13.0	0.18		16	8.0	
102-140	3	0	0	2	4	75		1.35	1.63	0.063	28.7	27.0	12.6	0.19		15	7.9	
000-20								1.20	1.63	0.108	39.7	37.6			1.9D			
020-30								1.20	1.63	0.108	41.7	41.1						

DEPTH	ORGANIC MATTER 6A1A ORGN CARB	6B1A NITG	C/N	IRON 6C2B EXT FE	PHOS 6S1A TOTL	EXTRACTABLE BASES 5B4A- 6N2E CA	6O2D MG	6P2B NA	6Q2B K	SUM EXTB	ACTY 6H2A BACL TEA	AL 6G1D KCL EXT	(CAT EXCH) 5A3A EXTB ACTY	5A6A NHAC	RATIO 8D1 NHAC TO CLAY	RATIO 8D3 CA TO MG	CA SAT NHAC	(BASE SAT) 5C3 EXTB ACTY	5C1 NHAC
CM	PCT	PCT		PCT	PCT	MEQ / 100 G											PCT	PCT	PCT
000-23	5.76E	0.424	14	0.6		43.1	8.4	0.1	0.6	52.2	8.3		60.5	42.6	1.20	5.1	101	86	122
023-33	2.53	0.180	14	0.8		27.7	9.1	0.2	0.6	37.6	6.4		44.0	35.2	0.95	3.0	79	85	107
033-51	1.45	0.106	14	0.7		24.2	9.0	0.2	0.5	33.9	5.2		39.1	31.9	0.88	2.7	76	87	106
051-68	0.92	0.066	14	0.9		22.7	8.6	0.2	0.5	32.0				27.9	0.80	2.6	81		115
068-81	0.39			0.8				0.2	0.4					20.2	0.70				
081-102	0.26			0.7				0.2	0.3					17.3	0.64				
102-140	0.26			0.8				0.3	0.4					15.9	0.64				
000-20																			
020-30																			

DEPTH	SATURATED PASTE 8E1 REST OHM-	8C1B PH	8A H2O	NA 5D2 ESP	NA 5E SAR	SALT 8D5 TOTL SOLU	GYP 6F1A	SATURATION EXTRACT 8A1- 8A1A EC	6N1B CA	6O1B MG	6P1A NA	6Q1A K	6I1A CO3	6J1A HCO3	6K1A CL	6L1A SO4	6M1A NO3	ATTERBERG 4F1 LQID LMIT	4F2 PLST INDX
CM	CM		PCT	PCT		PPM	PCT	MMHOS/ CM	MEQ / LITER									PCT	
000-23																		64F	16
023-33																			
033-51																		49F	23
051-68																			
068-81																			
081-102	2000	7.7																39F	17
102-140	3000	7.5																	
000-20																			
020-30																			

ANALYSES BY MINNESOTA AGRICULTURAL EXPERIMENT STATION, ST PAUL, MN. MINERALOGY BY X-RAY ANALYSIS. TOTAL PHOSPHORUS BY NITRIC-PERCHLORIC DIGESTION. AVAILABLE PHOSPHORUS BY BRAY'S NO 1 EXTRACTANT.

DEPTH	MINERALOGY MONT	VERM	ILLITE	KAOL	QUARTZ	TOTAL P	AVAIL P
	PCT LT .002MM					(--LBS/A--)	
000-23	65	0	20	10	5	1426	18
023-33						478	8
033-51	80	0	10	10	0		5
051-68						806	5
068-81							4
081-102	80		10	10	0	910	4
102-140							5

(A) BULK DENSITY AND WATER CONTENT ANALYSES BY THE SOIL SURVEY INVESTIGATIONS UNIT, LINCOLN, NE. UNLESS OTHERWISE INDICATED REMAINING ANALYSES BY THE SOIL SURVEY INVESTIGATIONS UNIT, BELTSVILLE, MD.
(B) COLLECTED FROM ADJACENT CULTIVATED FIELD.
(C) ESTIMATED.
(D) MICRO-PENETRATION RESISTANCE - A ROD 0.6 CM DIA IS SLOWLY PUSHED INTO BULK DENSITY CLOD, EQUILIBRATED AT 1/10-BAR, A DISTANCE OF 0.6 CM USING A POCKET PENETROMETER. UNITS ARE FORCE (KG) AND NOT ESTIMATES OF UNCONFINED COMPRESSIVE STRENGTH.
(E) ORGANIC CARBON IS 22 KG/M SQ TO A DEPTH OF 1 M (6A).
(F) LL AND PI BY SOIL MECHANICS LAB, USDA-SCS, LINCOLN, NE.

Pedon classification: Typic Argiaquoll; fine-loamy, mixed, mesic.
Series classification: Same.
Soil: Cordova series.
Soil No.: S69 MN-7-11.
Location: Blue Earth County, Minnesota; SE1/4 of NE1/4, Sec. 9, T. 108 N., R. 26 W. (Mankato Twp.); about 800 feet north and 100 feet west of southeast corner of NE1/4.
Climate: Humid continental. Some characteristics of temperature in deg. F. are: annual normal - 46, winter normal - 17, summer normal - 71; some characteristics of precipitation in inches are: annual normal - 28, May through September - 18, normal annual snowfall - 40.
Parent material: Calcareous loamy glacial till (New Ulm) of the Des Moines Lobe, Late Wisconsin age.
Physiography: Central lowlands; Blue Earth Till Plain of H. E. Wright (1972).
Landscape setting: Level plane slope. General topography is nearly level with a few slight rises and depressions. Relative relief is about 5 feet. Elevation of the site is about 1,005 feet.

Major associated soils on the landscape near this site are of the Minnetonka and Rolfe series.
Vegetation: Mixed deciduous forest. Native vegetation probably was savanna.
Drainage: Poorly drained.
Erosion: Slight.
Permeability: Moderately slow to moderate.
Described by: R. J. Edwards and H. R. Finney on October 24, 1969.
Sampled by: L. Shields, R. J. Edwards, J. F. Cummins, J. J. Murray, and H. R. Finney on October 24, 1969.

A1 69B833 0 to 23 cm (0 to 9 inches) Black (N 2/) silty clay loam or clay loam; moderate very fine subangular blocky structure; friable, slightly plastic and slightly sticky; common roots; clear smooth boundary.

A3 69B834 23 to 33 cm (9 to 13 inches) Black (N 2/) clay loam; moderate to strong very fine subangular and angular blocky structure; friable, slightly plastic and slightly sticky; common roots; clear smooth boundary.

B21t 69B835 33 to 51 cm (13 to 20 inches) Black (2.5Y 2/1) to very dark gray (2.5Y 3/1) heavy clay loam; weak to moderate fine and medium prismatic structure parting to moderate to strong fine and very fine subangular and angular blocky structure; firm, plastic and sticky; many thin black (10YR 2/1) clay films on faces of peds; few thin porous grayish coatings on faces of peds; clear smooth boundary.

B22tg 69B836 51 to 68 cm (20 to 27 inches) Olive gray (5Y 4/2) to very dark grayish brown (2.5Y 3/2) heavy clay loam; few fine faint olive gray (5Y 4/2) mottles; weak to moderate fine and medium prismatic structure parting to moderate to strong subangular and angular blocky structure; firm, plastic and sticky; many thin and medium very dark gray (10YR 3/1) and black (10YR 2/1) clay films on faces of peds; clear smooth boundary.

B3tg 69B837 68 to 81 cm (27 to 32 inches) Olive gray (5Y 5/2) clay loam; common fine distinct light olive brown (2.5Y 5/4) mottles; weak fine and medium prismatic structure parting to weak fine and medium subangular blocky structure; firm, plastic and sticky; few thin very dark gray (10YR 3/1) clay films on faces of peds and few thick clay films in pores and root channels; few soft lime masses; few fine shale fragments; clear smooth boundary.

C1g 69B838 81 to 102 cm (32 to 40 inches) Olive gray (5Y 4/2) loam; common fine distinct light olive brown (2.5Y 5/4 and 2.5Y 5/6) mottles; weak coarse prismatic structure parting to weak fine subangular and angular blocky structure; friable, slightly plastic and slightly sticky; few black (10YR 2/1) clay films in old root channels; about 5 percent soft lime masses; slightly effervescent; clear smooth boundary.

C2 69B839 120 to 140 cm (40 to 58 inches) Olive brown (2.5Y 4/4) and light olive brown (2.5Y 5/4) loam; common fine and medium distinct dark gray (5Y 4/1) mottles; weak fine angular and subangular blocky structure; friable, slightly plastic and slightly sticky; common fine seams of gray (5Y 6/1) segregated lime; few reddish iron oxide stains; about 5 percent soft lime masses; strongly effervescent.

Pedon classification: Typic Argiaquoll; fine-loamy, mixed, mesic.
Series classification: Same.
Soil: Cordova series.
Soil No.: S69MN-7-11.
Location: Blue Earth County, Minnesota; SE1/4 of NE1/4, Sec. 9, T. 108 N., R. 26 W. (Mankato Twp.); about 800 feet north and 100 feet west of southeast corner of NE1/4.
Climate: Humid continental. Some characteristics of temperature in deg. F. are: annual normal - 46, winter normal - 17, summer normal - 71; some characteristics of precipitation in inches are: annual normal - 28, May through September - 18, normal annual snowfall - 40.
Parent material: Calcareous loamy glacial till (New Ulm) of the Des Moines Lobe, Late Wisconsin age.
Physiography: Central lowlands; Blue Earth Till Plain of N. E. Wright (1972).
Landscape setting: Level plane slope. General topography is nearly level with a few slight rises and depressions. Relative relief is about 5 feet. Elevation of the site is about 1,005 feet. Major associated soils on the landscape near this site are of the Minnetonka and Rolfe series.
Vegetation: Mixed deciduous forest. Native vegetation probably was savanna.
Drainage: Poorly drained.
Erosion: Slight.
Permeability: Moderately slow to moderate.
Described by: R. J. Edwards and H. R. Finney on October 24, 1969.
Sampled by: L. Shields, R. J. Edwards, J. F. Cummins, J. J. Murray, and H. R. Finney on October 24, 1969.

Remarks: Colors are for moist soil. These samples were obtained from a pit with approximate dimensions of 1 x 3 x 2 m in depth.

Micromorphological studies were made on the B21t, B22tg, and B3tg horizons by Gabriella Carmean under the direction of R. H. Rust. A brief summary of her findings using Brewer's terminology follows:

B21t horizon
There is no obvious orientation of the matrix; the fabric can be classified as skelsepic, the skeleton grains are generally covered by a plasma separation--argillans. The rest of the matrix

[redacted]

magnification present a lacy pattern; they are mainly channels with branching patterns--metavoids (with smooth walls) and a great number of vughs interconnected by very small and narrow channels. Thin argillans appear as grain cutans and also as void cutans, very thin, predominantly yellow. Sesquans are usually globules and nodules.

B22t horizon
Orientation of plasma: skelvosepic with well developed plasma separations in the voids and also at the surface of the skeleton grains. Skeleton representing 9 percent of volume seems to be represented by feldspar and opaque anisotropic minerals. Voids representing 21 percent are mainly metavoids, or rounded vughs connected with narrow channels. The cutans are very thin in the voids but, in the big voids which are connected with the exterior of the peds, there is a fine material of grey black color which fills some of the voids--without forming cutans. Some sesquans are present in the horizon.

B3t horizon
The matrix shows little orientation. The fabric is mainly skel-vosepic; plasma separations occurring as cutans lining soils and around skeleton particles. The skeleton fraction is much increased (to about 30 percent). Shale is predominant in much of the material. Voids are represented by some

SOIL CLASSIFICATION-TYPIC DYSTROCHREPT

U. S. DEPARTMENT OF AGRICULTURE

COARSE-LOAMY OVER SANDY, MIXED, FRIGID

SERIES - - - - - - CROMWELL SERIES

SOIL CONSERVATION SERVICE, MTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

SOIL NO - - - - - - S68MN-9-7 COUNTY - - - CARLTON

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 68L1170-68L1178 FEBRUARY 1977

DEPTH CM	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B (PCT LT 2MM) SAND 2-.05	SILT .05-.002	CLAY LT .002	FINE CLAY LT .0002	VCOS 2-1	CORS 1-.5	MEDS .5-.25	FNES .25-.10	VFNS .10-.05	COSI .05-.02	FNSI .02-.002	VFSI .002-.1	RATIO FAML TEXT	RATIO INTR II	FINE CLAY TO CLAY PCT	NON-CO3 CLAY PCT	8D1 15-BAR TO CLAY
CCC-5	A1	56.5	36.7	6.8		2.7	16.8	19.8	13.7	3.5	20.8	15.9		52.9	28.4			1.03
C05-8	A2	51.2	43.7	5.1		3.8	11.8	17.6	14.1	3.9	23.9	19.8		47.3	32.0			.78
C08-20	B21HIR	57.8	37.9	4.3		4.3	14.2	19.9	15.0	4.4	22.7	15.2		53.4	31.6			.74
C20-38	B22HIR	64.3	31.3	4.4		6.2	17.4	21.4	15.8	3.5	19.C	12.3		60.8	27.2			.61
C38-56	2B23	94.1	2.5	3.4		15.9	4C.3	26.9	10.5	.5	1.0	1.5		93.6	3.3			.29
C56-79	2B31	96.5	1.6	1.9		.6	5.9	4C.9	46.4	2.7	1.1	.5		93.8	16.1			.53
C79-102	2B32	97.8	1.1	1.1		1.2	25.6	S4.6	15.3	1.C	.6	.5		96.8	4.3			
102-122	2C1	98.5	.6	.9		18.2	47.1	25.7	7.1	.3	.1	.5		98.2	1.7			
122-175	2C2	98.1	1.1	.8		1.8	12.0	4C.7	39.9	3.8	.7	.4		94.3	18.2			

DEPTH CM	(PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2) VOL. (WEIGHT) GT 2 PCT	GT 75 PCT	75-20 (PCT LT 75)	20-5	5-2	LT .C74 PCT LT2C	BULK DENSITY 20-2 PCT	4A1D 1/3-BAR G/CC	4A1H OVEN DRY G/CC	4D1 COLE	WATER CONTENT 4B1C 1/10 BAR PCT	4B1C 1/3-BAR PCT	4B2 15-BAR PCT	4C1 WRD CM/CM	CARBONATE 6E1B LT 2 PCT	3A1A LT .002 PCT	pH 8C1A 1/1 H2O	8C1E 1/2 CACL
000-5		0	0	0	0	46	0						7.0				6.0	5.2
005-8		0	0	TR	TR	51	TR						4.0				5.1	4.2
008-20		0	TR	3	2	43	5						3.2				5.2	4.3
020-38		C	TR	2	4	36	6						2.7				5.0	4.2
C38-56		C	0	4	11	5	15						1.0				5.4	4.3
C56-79		C	0	TR	TR	4	TR						1.0				5.4	4.3
C79-102		C	0	TR	TR	3	TR						.9				5.5	4.5
102-122		0	TR	9	12	1	21						1.2				5.7	4.4
122-175		0	0	2	2	3	4						.7				5.7	4.5

DEPTH CM	(ORGANIC MATTER) 6A1A ORGN CARB PCT	6B1A NITG PCT	C/N	IRON 6C2A EXT FE PCT	PHOS 6S1A TOTL UG/G	(EXTRACTABLE BASES 5B4A) 6N2E CA	6O2D MG	6P2A NA	6Q2A K	SUM EXTB / 100	ACTY 6H1A BACL TEA	AL 6G1C KCL EXT	(CAT EXCH) 5A3A EXTB ACTY	5A6A NHAC	RATIO 8D1 NHAC TO CLAY	RATIO 8D3 CA TO MG	CA SF SAT NHAC PCT	(BASE SAT) 5C3 EXTB ACTY PCT	5C1 NHAC PCT
						(MEQ G)													
CC0-5	3.92	.196	20	.8	145A	5.6	2.1	.1	.5	8.3	8.9		17.2	16.5	2.43	2.7	34	48	50
CC5-8	1.83	.097	19	.6	245A	3.1	.7	.1	.2	4.1	7.5	.5	11.6	25.2	4.94		12	35	16
C08-20	.72	.C40	18	.7	290A	.6	.1	.1	.1	.9	7.8	1.3	8.7	5.7	1.33		11	10	16
C2C-38	.30	.019		.7	75A	.4	.1	.1	.1	.7	6.7	1.6	7.4	4.6	1.05		9	9	15
038-56	.15			.7	3C0A	.5	.2	.1	.1	.9	4.1	1.2	5.0	3.9	1.15		13	18	23
056-79	.04			.3	75A	.4	.3	.1	.1	.9	1.8	.7	2.7	2.1	1.11		19	33	43
079-102	.07				155A														
102-122	.09				280A														
122-175	.06				90A														

DEPTH CM	(SATURATED PASTE) 8E1 REST CM-	8C1B PH	8A H2O PCT	NA 5D2 ESP PCT	NA 5E SAR	SALT 8D5 TOTL SOLU PPM	GYP 6F1A PCT	(SATURATION EXTRACT 8A1) 8A1A EC MMHOS/CM	6N1B CA	6O1B MG	6P1A NA	6Q1A K	6I1A CO3	6J1A HCO3	6K1A CL	6L1A SO4	6M1A NO3	ATTERBERG 4F1 LQID LMIT PCT	4F2 PLST INDX
									(MEQ / LITER)										
COC-5																			
C05-8																			
008-20																			
C20-38		4.8	16.3			3C		.32											
038-56																			
056-79																			
079-102		5.4	27.6			2C		.09											
1C2-122																			
122-175																			

(A) UG/G - PERCHLORIC ACID DIGESTION, AMMONIUM MOLYBDATE AND STANNOUS CHLORIDE ACID COLORIMETRY. ANALYSIS BY M. SINGER INSTITUTE OF AGRICULTURE, UNIVERSITY OF MINNESOTA, ST.PAUL, MINNESOTA.

Pedon classification: Typic Dystrochrept; coarse loamy over sandy, mixed frigid.
Series classification: Same.
Soil: Cromwell series.
Soil No.: S68MN-9-7
Location: Carlton County, Minnesota; NW1/4, NW1/4, SE1/4, Sec. 24, T. 48 N., R. 19 W.; about 600 feet south and 100 feet east of the northwest corner of the SE1/4 of the section. About 46 deg. 38 min. north latitude and 92 deg. 42 min. west longitude.
Climate: Humid continental. Some characteristics of temperature in deg. F. are: annual normal - 40, winter normal - 12, summer normal - 65; some characteristics of precipitation in inches are mean annual - 28, May to September - 19, mean snowfall - 55.
Parent material: Noncalcareous outwash consisting of a thin coarse-loamy mantle over sandy sediments of the Nickerson phase of the Superior Lobe of the Late Wisconsin glaciation.
Physiography: Central Lowlands; Outwash plain in Brainerd-Automba Drumlin Area (H. E. Wright, 1972).
Landscape setting: Site has a level plane slope. Local relief is about 1 m. Dominant soils in the immediate area are one of this and the Omega series and Histosols.
Vegetation: Deciduous-coniferous plant formation; chiefly aspen; understory is chiefly hazel.
Drainage: Well drained.
Erosion: None.
Ground water: At 160 cm.
Permeability: Moderately rapid.
Moisture: Moist throughout the profile.
Described by: R. Lewis and H. Finney on October 10, 1968.
Sampled by: L. Shields, G. Holmgren, and R. Paulson on October 10, 1968.

O 1 to 0 cm (1/2 to 0 inches). Leaves, branches and twigs in varying stages of decomposition.

A1 68L1170 0 to 5 cm (0 to 2 inches). Black (10YR 2/1) fine sandy loam; moderate fine and very fine granular structure; very friable; about 1 percent whitish (unstained) sand grains; abundant very fine and medium random roots; about 1 percent fine gravel; abrupt wavy boundary. (1 to 5 cm thick)

A2 68L1171 5 to 8 cm (2 to 3 inches). Reddish gray (5YR 5/2) fine sandy loam; weak very fine and fine subangular blocky structure; very friable; abundant very fine through medium random roots; about 1 percent fine gravel; discontinuous horizon occupying about 15 percent of pedon; abrupt wavy boundary. (0 to 6 cm thick)

B21hir 68L1172 8 to 20 cm (3 to 8 inches). Dark brown (7.5YR 4/4) grading to (7.5Y 3/4) fine sandy loam to sandy loam; moderate fine and very fine subangular blocky structure with a few medium size peds; very friable; abundant fine and medium random roots; about 1 percent fine gravel; gradual smooth boundary. (10 to 18 cm thick)

B22hir 68L1173 20 to 38 cm (8 to 15 inches). Dark brown (7.5YR 4/4) sandy loam; weak medium and coarse subangular blocky structure parting to weak fine subangular blocky structure; very friable; plentiful fine and medium random roots; about 1 percent fine gravel; abrupt wavy boundary. (10 to 20 cm thick)

IIB23 68L1174 38 to 56 cm (15 to 22 inches). Reddish brown (5YR 4/4) grading to dark reddish brown (5YR 3/4) loamy coarse sand; massive; very friable; about 10 percent coarse fragments ranging from 2 to 5 mm; many thin stains on sand particles; few fine random roots; abrupt smooth boundary. (15 to 25 cm thick)

IIB31 68L1175 56 to 79 cm (22 to 31 inches). Reddish brown (5YR 4/4) sand; about 50 percent massive breaking into weakly coherent chunks, remainder is single grain; loose; very few fine roots; very thin stains on about 50 percent of the sand grains; a few wavy 1 to 2 mm bands of dark reddish brown (5YR 3/4); gradual smooth boundary. (18 to 33 cm thick)

IIB32 68L1176 79 to 102 cm (31 to 40 inches). Reddish brown (5YR 4/4) sand; loose; very few fine roots; few 8 to 14 cm thick lenses and masses of coarse and very coarse sand and very fine gravel; very thin stains on about 50 percent of sand grains; abrupt smooth boundary.

IIC1 68L1177 102 to 122 cm (40 to 48 inches). Reddish brown (5YR 5/3) coarse sand; single grain; loose; very few fine roots; about 10 percent gravel, mostly 2 to 10 mm with some to 15 mm; abrupt smooth boundary. (15 to 25 cm thick)

IIC2 68L1178 122 to 175 cm (48 to 69 inches). Reddish brown (5YR 5/3) sand; few coarse distinct dark reddish brown (5YR 3/3) mottles; single grain; loose; very few fine roots; about 20 percent weakly coherent chunks that part readily to single grain; abrupt smooth boundary.

IIC3 175 to 193 cm (69 to 76 inches). Reddish brown (5YR 5/3) gravelly coarse sand; single grain; loose; about 15 percent fine gravel. (Not sampled)

Remarks: Soil colors are for moist conditions. Samples were obtained from a pit with dimensions of about 1.5 by 2.5 by 2 m in depth. Profile is considered typical for this series except for mottles in the C2 horizon. Soil temperature at 50 cm was 8.75 deg. C. and at 100 cm was 9.0 deg. C.

SOIL CLASSIFICATION-TYPIC ARGIUDOLL
FINE-LOAMY, MIXED, MESIC
SERIES - - - - - - -DAKOTA TAXADJUNCT

SOIL NO - - - - - - S70MN-24-2 COUNTY - - - FREEBORN

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 70L1100-70L1108

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, MTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B														RATIO
					FINE	SAND					SILT			FAML	INTR	FINE	NON-	8D1
		SAND	SILT	CLAY	CLAY	VCOS	CORS	MEDS	FNES	VFNS	COSI	FNSI	VFSI	TEXT	II	CLAY	CO3-	15-
		2-	.05-	LT	LT	2-	1-	.5-	.25-	.10-	.05	.02	.005-	SAND	.2-	TO	CLAY	BAR
		.05	.002	.002	.0002	1	.5	.25	.10	.05	.02	.002	.002	2-.1	.02	CLAY		TO
CM		PCT LT 2MM														PCT	PCT	CLAY
000-20	AP	43.1	38.2	18.7		1.6	10.1	14.1	13.8	3.5	17.0	21.2		39.6	26.1		19	.47
020-32	B21T	27.5	50.0	22.5		.5	5.5	8.5	9.7	3.3	21.3	28.7		24.2	28.6		23	.42
032-50	B22T	31.7	43.8	24.5		.7	5.1	9.0	12.3	4.6	19.4	24.4		27.1	29.6		25	.41
050-72	2B23T	63.1	20.5	16.4		2.6	11.3	19.2	23.3	6.7	10.2	10.3		56.4	26.4		16	.42
072-88	2B24T	84.9	4.6	10.5		8.3	25.5	30.6	18.9	1.6	1.6	3.0		83.3	8.6		11	.47
088-110	2B31T	84.5	5.8	9.7		10.1	32.2	27.6	13.6	1.0	1.3	4.5		83.5	5.9		10	.54
110-126	2B32	91.4	4.0	4.6		17.9	26.8	25.5	19.2	2.0	1.5	2.5		89.4	9.2		5	.61
126-147	2C1	92.2	4.5	3.3		18.0	24.3	26.6	21.2	2.1	2.4	2.1		90.1	10.5		3	.70
147-177	2C2	93.5	4.0	2.5		3.1	9.1	13.6	60.1	7.6	1.3	2.7		85.9	38.0		3	.84

DEPTH	(PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2) VOL.		WEIGHT				BULK DENSITY			WATER CONTENT				CARBONATE		PH	
	GT 2	GT 75	75-20	20-5	5-2	LT .074	4A1D 20-2 1/3- BAR	4A1H OVEN DRY	4D1 COLE	4B1C 1/10 BAR	4B1C 1/3- BAR	4B2 15- BAR	4C1 WRD CM/ CM	6E1B LT 2	3A1A LT .002	8C1A 1/1 H2O	8C1E 1/2 CACL
CM	PCT	PCT	PCT LT 75			LT20	G/CC	G/CC		PCT	PCT	PCT		PCT	PCT		
000-20	TR	0	0	0	TR	59	TR	1.48	1.61	.029	22.1	19.7	8.7	.17	2.2B		5.6	5.4
020-32	TR	0	0	0	TR	74	TR	1.44	1.55	.025	25.6	23.2	9.4	.20	2.1B		5.6	5.2
032-50	TR	0	0	0	TR	71	TR	1.33	1.50	.042	29.1	27.2	10.1	.23	2.5B		5.3	4.9
050-72	12	0	0	9	10	33	19	1.52	1.65	.024	17.4	15.6	6.9	.12			5.2	4.8
072-88	18	0	0	12	15	12	27	1.60A					4.9				5.2	4.9
088-110	16	0	TR	11	13	12	25	1.60A					5.2				5.5	5.0
110-126	24	0	TR	17	18	6	35	1.60A					2.8				6.1	6.0
126-147	23	0	TR	16	18	6	34	1.60A					2.3			3 0	8.0	7.5
147-177	13	0	TR	10	11	7	21	1.60A					2.1			2 0	8.4	7.6

DEPTH	(ORGANIC MATTER) 6A1A ORGN CARB	6B1A NITG	C/N	IRON 6C2B EXT FE	PHOS TOTL	EXTRACTABLE BASES 5B4A- 6N2E CA	6O2D MG	6P2B NA	6Q2B K	SUM EXTB	ACTY 6H1A BACL TEA	AL 6G1E KCL EXT	(CAT EXCH) 5A3A EXTB ACTY	5A6A NHAC	RATIO 8D1 NHAC TO CLAY	RATIO 8D3 CA TO MG	CA 5F1 SAT NHAC PCT	(BASE SAT) 5C3 EXTB ACTY PCT	5C1 NHAC PCT
CM	PCT	PCT		PCT	PCT	MEQ / 100 G													
000-20	1.62C	.148	11	0.7		11.1	3.4	0.2	0.4	15.1	6.7		21.8	16.6	0.89	3.3	67	69	91
020-32	0.92	.099	9	1.0		10.6	3.5	0.2	0.3	14.6	8.1		22.7	16.7	0.74	3.0	63	64	87
032-50	0.63	.058	11	1.1		11.2	4.6	0.2	0.4	16.4	7.1	0.5	23.5	17.9	0.73	2.4	63	70	92
050-72	0.42			0.8		6.5	3.5	0.2	0.3	10.5	4.4	0.4	14.9	12.2	0.74	1.9	53	70	86
072-88	0.26			0.6		4.9	2.6	0.2	0.3	8.0	3.1	0.1	11.1	9.1	0.87	1.9	54	72	88
088-110	0.12			0.4		4.0	2.1	0.3	0.2	6.6	1.8	0.1	8.4	7.2	0.74	1.9	56	79	92
110-126	0.12			0.8		3.6	1.7	0.2	0.1	5.6	1.5		7.1	5.0	1.09	2.1	72	79	112
126-147	0.11			0.5		3.4D	0.8D	0.2	0.1	4.5				2.9	0.88				
147-177	0.11			0.4		2.7D	0.8D	0.2	0.1	3.8				3.3	1.32				

DEPTH	(SATURATED PASTE) 8E1 SAT	8C1B PH	8A H2O	NA 5D2 SAT	NA 5E EXP	SALT 8D5 TOTL	GYP 6F1A	SATURATION EXTRACT 8A1- 8A1A EC	6N1B CA	6O1B MG	6P1B NA	6Q1B K	6I1A CO3	6J1A HCO3	6K1A CL	6L1A SO4	6M1A NO3	ATTERBERG 4F1 LQID	4F2 PLST
000-20																		29E	9
020-32																		35E	15
032-50																			
050-72																			
072-88																			
088-110	7100	5.3	24.2	4	1	30		0.23	0.9	0.6	0.6	0.1							
110-126																			
126-147																			
147-177																			

ANALYSES BY MINNESOTA AGRICULTURAL EXPERIMENT STATION, ST PAUL, MN. MINERALOGY, X-RAY ANALYSIS. TOTAL PHOSPHORUS, NITRIC-PERCHLORIC DIGESTION. AVAILABLE PHOSPHORUS, BRAY'S NO 1 EXTRACTANT.

(A) ESTIMATED.

(B) MICRO-PENETRATION RESISTANCE - A ROD 0.6 CM DIA IS SLOWLY PUSHED INTO BULK DENSITY CLOD, EQUILIBRATED AT 1/10-BAR, A DISTANCE OF 0.6 CM USING A POCKET PENETROMETER. UNITS ARE FORCE (KG) AND NOT ESTIMATES OF UNCONFINED COMPRES-

Pedon classification: Typic Argiudoll; fine-loamy, mixed, mesic*
Series classification: Typic Argiudolls; fine-loamy over sandy or sandy-skeletal, mixed, mesic.
Soil: Dakota taxadjunct*
Soil No.: S70 MN-24-2.
Location: Freeborn County, Minnesota; about 1 mile south of Glenville; about 1,290 feet west and 450 feet north of the southeast corner of Sec. 7, T. 101 N., R. 20 W.; about 93 deg. 16 min west longitude and 43 deg. 34 min. north latitude.
Climate: Humid continental. Some features of temperature in deg. F.: annual normal - 46, summer normal - 70, winter normal - 18; some features of precipitation in inches: annual normal - 30, May through September - 19, annual normal snowfall - 40.
Parent material: Outwash of the Des Moines Lobe, Late Wisconsin age, consisting of a loamy mantle over a sandy substrata.
Physiography: Central lowlands; Valley Train in Owatonna Moraine Area (of Wright) and Cedar Valley Outwash (MN Soil Atlas).
Landscape setting: Pedon has level plane slope. Topography in the immediate vicinity is mostly nearly level. Relative relief is about 5 feet, and the valley train is about 2 miles wide. Elevation is about 1,225 feet.
Vegetation: Alfalfa field. Native vegetation was tall grass prairie or savanna.
Drainage: Well drained.
Erosion: None.
Moisture: Moist.
Permeability: Moderately rapid in the part of the solum in the upper sediment and rapid below that.
Described by: J. F. Cummins on October 21, 1970.
Sampled by: R. B. Grossman, E. R. Gross, R. H. Rust, and J. F. Cummins on October 21, 1970.

Ap 70L1100 0 to 20 cm (0 to 8 inches) Black (10YR 2/1) loam, very dark brown (10YR 2/2) rubbed, dark brown (10YR 3/3) dry; weak fine subangular blocky structure; friable; abrupt smooth boundary.

B21t 70L1101 20 to 32 cm (8 to 13 inches) Dark brown (10YR 3/3) loam, very dark grayish brown (10YR 3/2) ped faces; moderate fine subangular blocky structure; friable; few very dark brown (10YR 2/2) tongues; thin patchy clay films on faces of peds; abrupt wavy boundary.

B22t 70L1102 32 to 50 cm (13 to 20 inches) Dark yellowish brown (10YR 4/4) loam near clay loam, dark brown (10YR 4/3) ped faces; weak fine and medium prismatic structure parting to moderate fine and medium subangular blocky structure; friable; thin continuous clay films on faces of peds; abrupt wavy boundary.

IIB23t 70L1103 50 to 72 cm (20 to 28 inches) Dark yellowish brown (10YR 4/4) sandy clay loam or sandy loam, dark brown (10YR 4/3) ped faces; weak fine and medium prismatic structure parting to moderate fine and medium subangular blocky structure; very friable; thin continuous clay films on faces of peds; abrupt wavy boundary.

IIB24t 70L1104 72 to 88 cm (28 to 35 inches) Dark yellowish brown (10YR 3/4) gravelly loamy sand; few medium distinct dark brown (7.5YR 3/4) mottles; weak medium and coarse subangular blocky structure; very friable; coarse sand and coarser particles mostly shale; few thin clay films on faces of peds and few clayey bridges between sand grains; abrupt wavy boundary.

IIB31t 70L1105 88 to 110 cm (35 to 43 inches) Brown (10YR 5/3) and yellowish brown (10YR 5/4) loamy coarse sand; single grain; loose; few clayey bridges between sand grains; abrupt wavy boundary.

IIB32 70L1106 110 to 126 cm (43 to 50 inches) Dark brown (10YR 4/4) gravelly coarse sand; single grain; loose; high in content of shale particles; about 1 percent greater than 3/4 inch; abrupt wavy boundary.

IIC1 70L1107 126 to 147 cm (50 to 58 inches) Grayish brown (2.5Y 5/2) and light olive brown (10YR 5/4) gravelly sand; single grain; loose; calcareous; abrupt wavy boundary.

IIC2 70L1108 147 to 177 cm (58 to 70 inches) (Auger sample) Light brownish gray (2.5Y 6/2), dark grayish brown (2.5Y 4/2) and strong brown (7.5YR 5/8) fine sand; single grain; loose; calcareous.

Remarks: Samples were collected from a pit that was dug with a backhoe.

*The B horizon in this pedon is marginal between an argillic and cambic horizon. Also, the transition zone between the fine-loamy part of the B2t horizon and the sandy lower horizons

SOIL CLASSIFICATION-GLOSSIC EUTROBORALF
FINE-LOAMY, MIXED
SERIES - - - - - - -DULUTH SERIES

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, MTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

SOIL NO - - - - - - S68MN-9-4 COUNTY - - - CARLTON

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 68L1183-68L1192 FEBRUARY 1977

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B															RATIO
		SAND 2-.05	SILT .05-.002	CLAY .002	FINE CLAY LT .0002	VCOS 2-1	CORS 1-.5	MEDS .5-.25	FNES .25-.10	VFNS .10-.05	COSI .05-.02	FNSI .02-.002	VFSI .005-.002	FAML TEXT SAND 2-.1	INTR II .2-.02	FINE CLAY TO CLAY	NON-CO3-CLAY	8C1 15-BAR TO CLAY
CM		PCT LT 2MM														PCT	PCT	
C00-5	A1	30.9	61.2	7.9		.5	2.2	5.7	12.3	10.2	35.2	26.0		20.7	51.7			1.27
C05-18	BHIR1	23.5	67.3	9.2		.3	1.6	4.5	8.8	8.3	40.8	26.5	5.4	15.2	53.2			.57
C18-30	BHIR2	27.8	65.0	7.2		1.0	2.2	5.3	10.4	8.8	39.9	25.1		18.9	53.8			.65
C30-33	B*2X	36.4	53.2	10.4		1.5	3.2	7.8	14.7	9.2	26.7	26.5		27.2	43.1			.36
C33-46	B*2B*2	33.8	46.2	20.0		.9	2.6	7.1	14.8	8.5	22.0	24.2		25.3	37.6			.38
C46-74	B*21T	34.1	43.8	22.1		.7	2.5	7.4	15.1	8.5	20.8	23.0		25.6	36.5			.38
C74-91	B*22T	33.6	43.5	22.9		.6	2.6	7.2	14.9	8.3	20.0	23.5	6.5	25.3	35.5			.39
C91-119	B*31T	34.0	44.9	21.1		.6	2.4	7.5	15.0	8.6	21.2	23.7		25.4	37.2			.43
119-163	B*32T	34.4	45.3	20.3		1.0	2.6	7.4	15.0	8.5	21.6	23.7		25.8	37.5			.45
163-183	C	35.8	44.0	20.2		.7	2.6	8.2	15.7	8.6	21.4	22.6	7.4	27.2	37.7			.44

DEPTH	(PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2) VOL. GT 2	GT 75	WEIGHT 75-20	20-5	5-2	LT .074	2D-2	BULK DENSITY 4A1D 1/3-OVEN DRY	4A1H COLE	4D1	WATER CONTENT- 4A1C 1/10 BAR	4B1C 1/3-BAR	4B2 15-BAR	4C1 WRD CM/CM	CARBONATE 6E1B LT 2	3A1A LT .002	PH 8C1A 1/1 H2O	8C1E 1/2 CACL
CM	PCT	PCT	PCT LT 75				LT2D	G/CC	G/CC		PCT	PCT	PCT		PCT	PCT		
C00-5	TR	C	0	TR	TR	76	TR	.97	1.12	.049		46.0	10.0	.35			5.2	4.4
C05-18	TR	C	0	TR	TR	82	TR	1.32	1.37	.012		26.8	5.2	.29			5.5	4.5
C18-30	2	0	TR	2	1	76	3	1.40A					4.7				5.6	4.6
C30-33	2	0	TR	2	1	67	3	1.50A					3.7				5.5	4.5
C33-46	TR	0	TR	TR	TR	71	TR	1.77	1.84	.013		17.0	7.6	.17			5.3	4.7
C46-74	1	C	TR	1	1	69	2	1.74	1.87	.024		15.5	8.5	.12			5.7	4.9
C74-91	TR	C	TR	TR	TR	71	TR	1.70A					8.9				6.3	5.5
C91-119	1	C	0	2	TR	69	2	1.77	1.88	.020		16.5	9.0	.13			6.6	5.8
119-163	1	C	0	1	1	69	2	1.75	1.88	.024		17.7	9.1	.15			6.9	6.1
163-183	TR	C	0	TR	TR	69	TR	1.76	1.87	.020		17.0	8.8	.14			6.8	6.3

DEPTH	(ORGANIC MATTER) 6A1A CRGN CARB	6B1A NITG	C/N	IRON 6C2A EXT FE	PHOS 6S1A TOTL	(EXTRACTABLE BASES 5B4A) 6N2C CA	6Q2C MG	6P2A NA	6Q2A K	SUM EXTB	ACTY 6H1A BACL TEA	AL 6G1C KCL EXT	(CAT EXCH) 5A3A EXTB ACTY	5A6A NHAC	RATIO 8D1 NHAC TO CLAY	RATIO 8D3 CA TO MG	CA 5F SAT NHAC	(BASE SAT) 5C3 EXTB ACTY	5C1 NHAC
CM	PCT	PCT		PCT	UG/G	(- - - - - - - - - - -MEQ / 100 G- - - - - - - - - - -)									CLAY	MG	PCT	PCT	PCT
C00-5	6.40B	.273	23	.6	195C	11.1	1.6	.1	.3	13.1	15.3	.2	28.4	21.4	2.71	6.9	52	46	61
C05-18	1.3C	.064	20	.9	290C	3.5	1.1	.1	.2	4.9	12.2	1.4	17.1	10.8	1.17	3.2	32	29	45
C18-30	.65	.052	13	1.2	390C	2.4	1.1	.1	.2	3.8	11.1	1.1	14.9	8.8	1.22	2.2	27	26	43
C30-33	.19	.C15		1.3	270C	2.6	1.9	.1	.2	4.8	4.C	.6	8.8	6.5	.63	1.4	40	55	74
C33-46	.19	.C17		1.4	125C	6.1	4.5	.1	.3	11.0	4.2	.4	15.2	12.2	.61	1.4	50	72	90
C46-74	.15			1.3	195C	7.1	5.5	.2	.3	13.1	3.5		16.6	13.5	.61	1.3	53	79	97
C74-91	.C9			1.3	170C	7.8	6.4	.2	.3	14.7	2.3		17.0	14.4	.63	1.2	54	86	102
C91-119	.12			1.4	125C	7.9	6.4	.2	.2	14.7	2.2		16.9	14.3	.68	1.2	55	87	103
119-163	.12			1.5	145C	8.0	6.4	.2	.2	14.8	1.9		16.7	13.9	.68	1.3	58	89	106
163-183	.C8			1.3	165C	7.6	6.0	.3	.2	14.1	1.5		15.6	13.2	.65	1.3	58	90	107

DEPTH	(SATURATED PASTE) 8E1 REST CHK-	8C1B	PH	8A H2O	NA 5D2 ESP	NA 5E SAR	SALT 8D5 TOTL SOLU	GYP 6F1A	(SATURATION EXTRACT 8A1) EC	6N1B CA	6Q1B MG	6P1A NA	6Q1A K	6J1A CO3	6J1A HCO3	6K1A CL	6L1A SO4	6M1A NO3	ATTERBERG 4F1 LQID LMIT	4F2 PLST INDX
CM	CM			PCT	PCT		PPM	PCT	MMHOS/CM	(- - - - - - - - - - MEQ / LITER - - - - - - - - - -)									PCT	
C00-5																				
C05-18																				
C18-3C																				
C3C-33																				
C33-46																				
C46-74																			26C	10
C74-91																				
C91-119	4CCC	6.3		21.7			5C		.38											
119-163																				
163-183																			26D	10

IDENTIFICATION OF THE SPODIC HORIZON BY LABORATORY CRITERIA (E).

DEPTH	HORIZON	(PYROPHOSPHATE,PH10) 6C5A EXT FE PCT	6G5A EXT AL PCT	6A1B EXT C PCT	(CIT - DIT) 6C2A EXT FE PCT	6G7A EXT AL PCT	(PYROPHOSP) FE+AL / CLAY	AL+C / CLAY	PYRO FE+AL / C - C FE+AL	CEC -1/2 CLAY X THIC
C05-18	BHIR1	.4	.2		.9		.1			163

(A) ESTIMATED.
(B) [illegible]

(C) UG/G - PERCHLORIC ACID DIGESTION, AMMONIUM MOLYBDATE AND STANNOUS CHLORIDE ACID COLORIMETRY. ANALYSIS BY M. SINGER INSTITUTE OF AGRICULTURE, UNIVERSITY OF MINNESOTA, ST. PAUL, MINNESOTA.
(D) LL AND PI BY SOIL MECHANICS LABORATORY, USCA-SCS, LINCOLN, NEBRASKA.
(E) SOIL SURVEY INVESTIGATIONS UNIT, BELTSVILLE, MARYLAND.

Pedon classification: Glossic Eutroboralf; fine-loamy, mixed.
Series classification: Same.
Soil: Duluth series.
Soil No.: S68MN-9-4.
Location: Carlton County, Minnesota; NW1/4, NW1/4, Sec. 34, T. 47 N., R. 18 W.; 660 feet south and 150 feet east of the northwest section corner; about 92 deg. 36 min. west longitude and 46 deg. 31 min. north latitude.

Parent material: Reddish brown, fine-loamy glacial till of the Nickerson phase of the Superior Lobe

Pedon classification: Glossic Eutroboralf; fine-loamy, mixed.
Series classification: Same.
Soil: Duluth series.
Soil No.: S68MN-9-4.
Location: Carlton County, Minnesota; NW1/4, NW1/4, Sec. 34, T. 47 N., R. 18 W.; 660 feet south and 150 feet east of the northwest section corner; about 92 deg. 30 min. west longitude and 46 deg. 31 min. north latitude.
Climate: Humid continental. Some characteristics of temperature in deg. F. are: annual normal - 40, winter normal - 12, summer normal - 65; some characteristics of precipitation in inches are mean annual - 28, May to September - 19, mean snowfall - 55.
Parent material: Reddish brown, fine-loamy glacial till of the Nickerson phase of the Superior Lobe of the Late Wisconsin glaciation.
Physiography: Central lowlands; Barnum Clay-till Area (H. E. Wright, 1972); rolling moraine with relative relief of about 100 feet.
Landscape setting: Site has a 1 percent convex north facing slope on the shoulder of a knoll. Site is on the highest part of the immediate landscape. Soils of this series are dominant in the immediate vicinity. Elevation is about 1,140 feet.

Vegetation: Deciduous-coniferous forest with mostly maple with few birch and aspen, all trees are 6-12 inches DBH; few hazel in understory along with considerable grasses.
Drainage: Well drained.
Erosion: None.
Ground water: Deeper than 180 cm.
Permeability: Slow.
Moisture: Moist throughout the profile.
Described by: R. Lewis and H. Finney on October 8, 1968.
Sampled by: L. Shields, G. Holmgren, R. Rust, and J. Sharp on October 8, 1968.

B'21t 68L1188 46 to 74 cm (18 to 29 inches) Dark reddish brown (5YR 3/3) loam; moderate medium and coarse prismatic structure parting to moderate medium and coarse subangular and angular blocky structure; firm; few thin and medium porous coatings of dark reddish gray (5YR 4/2) on faces of prisms; common thin and moderately thick reddish brown (5YR 3/3) clay films on faces of peds; few microroots on prism faces; very few micro discontinuous random inped simple tubular pores on faces of prisms; about 1 percent coarse fragments; gradual smooth boundary.

B'22t 68L1189 74 to 91 cm (29 to 36 inches) Dark reddish brown (5YR 3/4) to (5YR 3/3) loam; moderate medium and coarse prismatic structure parting to moderate medium angular and some subangular blocky structure; firm; few microroots on faces of prisms; very few micro discontinuous random inped simple tubular pores on faces of peds; common thin dark reddish brown (5YR 3/3) clay films on faces of prisms and very few thin clay films on blocky peds; few thin porous dark reddish gray (5YR 4/2) coatings on faces of prisms; about 1 percent coarse fragments; gradual smooth boundary.

B'31t 68L1190 91 to 119 cm (36 to 47 inches) Dark reddish brown (5YR 3/4) loam; weak mostly coarse and some medium prismatic structure parting to weak medium and coarse angular blocky structure; firm; very few very fine roots along faces of prisms; very few micro random inped tubular pores; few thin clay films on vertical faces and very few thin clay films on faces of secondary peds; about 1 percent coarse fragments; diffuse smooth boundary.

B'32t 68L1191 119 to 163 cm (47 to 64 inches) Dark reddish brown (5YR 3/4) loam; weak medium prismatic structure parting to weak medium angular and subangular blocky structure; firm; very few very fine roots on faces of prisms; very few micro random inped tubular pores; few thin clay films on vertical faces of peds and very few thin clay films on faces of secondary peds; about 1 percent coarse fragments; diffuse smooth boundary.

C 68L1192 163 to 183 cm (67 to 72 inches) Dark reddish brown (5YR 3/4) loam; weak medium platy structure; friable to firm.

SOIL CLASSIFICATION-AQUIC HAPLOBOROLL
SANDY, MIXED
SERIES - - - - - - -FLAMING

SOIL NO - - - - - - S67MN-54-4 COUNTY - - - NORMAN

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 67L632-67L638

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, NTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

FEBRUARY 1977

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B														RATIO
		SAND	SILT	CLAY	FINE CLAY	VCOS	CORS	MEDS	FNES	VFNS	COSI	FNSI	VFSI	FAML TEXT	INTR LI	FINE CLAY	NON-CO3-	8D1 15-
CM		2-.05	.05-.002	LT .002	LT .0002	2-1	1-.5	.5-.25	.25-.10	.10-.05	.05-.02	.02-.002	.005-.002	SAND 2-.1	.2-.02	TO CLAY PCT	CLAY PCT	BAR TO CLAY
		PCT LT 2MM																
000-20	AP	88.8	6.4	4.8		1.0	3.7	11.9	63.9	8.4	2.9	3.5		80.4	45.7			.65
020-30	A3	89.2	5.9	4.9		.3	2.8	12.3	66.1	7.6	2.4	3.5		81.6	43.8			.51
030-43	B1	90.4	4.7	4.9		.5	3.5	13.4	65.7	7.3	2.8	1.9		83.1	43.2			.43
043-69	B2	93.8	2.6	3.6		.7	2.7	11.8	70.4	8.2	2.4	.2		85.6	46.1			.28
069-84	B3	95.1	1.8	3.1		.2	1.0	7.3	74.0	12.6	1.5	.3		82.5	56.5			.29
084-124	C1	94.6	2.6	2.8		.2	1.7	6.4	64.4	21.9	2.6	.1		72.7	67.1			.39
124-160	C2	94.7	3.1	2.2		.3	4.1	8.2	56.7	25.4	3.0	.1		69.3	75.3			.36

DEPTH	PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2						BULK DENSITY			WATER CONTENT			CARBONATE		PH	
	VOL. WEIGHT						4A1G	4A1H	4D1	4B1C	4B1C	4B2	4C1	6E1B	3A1A	8C1A	8C1E
	GT 2	GT 75	75-20	20-5	5-2	LT .074	20-2 PCT	1/3-BAR	OVEN DRY	COLE	1/10 BAR	1/3-BAR	15-BAR	WRD CM/	LT 2	LT .002	1/1 H2O	1/2 CACL
CM	PCT	PCT	PCT LT 75				LT20	G/CC	G/CC		PCT	PCT	PCT	CM	PCT	PCT		
000-20	TR	0	0	TR	TR	14	TR	1.48	1.51	.007	17.4		3.1	.21			5.8	
020-30	TR	0	0	0	TR	13	TR	1.58	1.60	.004	11.9		2.5	.15			6.0	
030-43	TR	0	0	TR	TR	12	TR	1.53	1.53		6.2		2.1	.07			5.5	
043-69	TR	0	0	1	1	8	2	1.50A					1.0				5.6	
069-84	TR	0	0	0	TR	5	TR	1.60A					.9				5.6	
084-124	TR	0	0	0	TR	12	TR	1.66	1.63		10.3		1.1	.15			5.6	
124-160	TR	0	0	0	TR	13	TR						.8				5.6	

DEPTH	ORGANIC MATTER			IRON	PHOS	EXTRACTABLE BASES 5B4A					ACTY	AL	(CAT EXCH)		RATIO	RATIO	CA	(BASE SAT)	
	6A1A ORGN CARB	6B1A NITG	C/N	6C2A EXT FE	6S1A TOTL	6N2E CA	6O2D MG	6P2A NA	6Q2A K	SUM EXTB	6H1A BACL TEA	6G1D KCL EXT	5A3A EXTB ACTY	5A6A NHAC	8D1 NHAC TO CLAY	8D3 CA TO MG	5F SAT NHAC	5C3 EXTB ACTY	5C1 NHAC
CM	PCT	PCT		PCT	PCT	MEQ				/ 100	G						PCT	PCT	PCT
000-20	1.81B					5.4	1.1	.1	.1	6.7	2.5		9.2	7.7	1.60	4.9		69	87
020-30	.62					4.2	1.1	.1	.1	5.5	2.5		8.0	6.7	1.37	3.8		69	82
030-43	.33					2.7	.6	.1	.1	3.5	2.2		5.7	5.0	1.02			61	70
043-69	.15					1.4	.4	.1	.1	2.0	.9		2.9	2.5	.69			69	80
069-84	.07					1.2	.4	.1	.1	1.8	.5		2.3	2.0	.65			78	90
084-124	.03																		
124-160						1.6	.6	.1	TR	2.3	.7		3.0	2.4	1.09			77	96

(A) ESTIMATED.
(B) 8 KG OF CARBON PER SQ METER TO A DEPTH OF 1 METER, METHOD 6A.

Soil classification: Aquic Haploboroll; sandy, mixed.
Series: Fleming series

Pedon No.: S67 MN-54-4.
Area: Norman County, Minnesota
Location: NW¼NE¼NW¼ sec. 21, T. 146 N., R. 44 W. (Sundahl Tps.)
Climate: Some characteristics of temperature in degrees F. are: annual normal - 41, winter normal - 10, summer normal - 68; some characteristics of precipitation in inches are: mean annual - 20, May to September - 14, mean snowfall - 35.
Vegetation: A soil-bank field dominated by grasses.
Parent material: Sandy, lacustrine sediments associated with glacial Lake Agassiz.
Physiography: Glacial Lake Agassiz plain; site occurs in sandy interbeach area between the Norcross and Herman beach ridges.
Topography: Site occurs in a gently undulating area, and it occurs near the crest of the ½ percent slope.
Drainage: Moderately well or somewhat poorly drained.
Ground water: None.
Erosion: Slight.
Permeability: Moderately rapid in the upper part, rapid in the lower part.
Moisture: Moist in the mollic epipedon, dry in the upper part of the B horizon, and moist in the lower part of the control section.
Sampled by: R. H. Jordan, G. S. Holmgren, H. R. Finney and D. D. Barron on October 17, 1967.
Described by: H. R. Finney.

Ap 67L632 0 to 20 cm (0 to 8 inches) Black (10YR 2/1) loamy fine sand; weak fine and medium sub-

calcareous; abrupt smooth boundary.

A3 67L633 20 to 30 cm (8 to 12 inches) Very dark gray (10YR 3/1) loamy fine sand; weak medium subangular blocky structure parting to weak fine granular structure; very friable; roots plentiful; about 10 percent yellowish brown krotovinas; noncalcareous; clear wavy boundary.

B1 67L634 30 to 43 cm (12 to 17 inches) Very dark grayish brown (10YR 3/2) ranging to brown (10YR 4/3) in parts fine sand; few fine faint dark grayish brown (10YR 4/2) mottles; weak medium subangular blocky structure; very friable; roots plentiful; about 10 percent very dark gray (10YR 3/1) krotovinas;

noncalcareous; clear wavy boundary.

SOIL CLASSIFICATION Udic Haploboroll; fine-loamy, mixed

SOIL Formdale Series LOCATION Stevens County, Minnesota

SOIL NOS. S57MN-75-1 LAB. NO. 6085-6091

SOIL SURVEY LABORATORY Lincoln, Nebraska DATE September 3, 1957

GENERAL METHODS 1A, 1B1a, 2A1, 2B

DEPTH INCHES	HORIZON	PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND >1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY <0.002	0.2-0.02	0.02-0.002	2A2 >2	TEXTURAL CLASS
0-8	Ap	2.0	3.5	4.4	9.8	7.5	40.9	31.9	31.1	23.2	3	cl
8-12	B21	0.8a	1.8	2.4	5.9	5.5	44.2	39.4	23.3	30.1	tr	sicl
12-16	B22	1.6b	2.3	2.7	7.0	5.9	44.5	36.0	23.7	31.2	2	cl/sicl
16-21	B3ca	4.8b	4.1	4.2	8.9	6.2	43.5	28.3	24.1	30.7	10	cl
21-32	Cca	2.4c	2.7	3.2	8.4	8.7	46.4	28.2	29.8	30.6	6	cl
32-40	C1	2.4b	3.1	4.2	9.7	8.3	45.3	27.0	28.9	30.4	5	l/cl
40-50	C2	3.7b	3.6	3.5	9.2	7.9	44.5	27.6	27.7	30.3	6.	cl/l

DEPTH INCHES	pH 8C1a SATURATED PASTE	1:5	1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	EST'D SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC x 10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
0-8	6.5	6.7	6.8	2.82	0.250	11		0.4	-				
8-12	6.9	6.9	7.2	1.25	0.126	10		0.5	-				
12-16	7.4	7.8	8.1	0.99	0.105	9		0.6	2				
16-21	7.9	8.5	8.7	0.59	0.063	9		0.5	22				
21-32	8.1	8.8	8.9	0.35				0.5	20				
32-40	8.1	8.8	8.9	0.23				0.6	22				
40-50	8.2	8.8	8.9	0.19				0.6	23				

DEPTH INCHES	5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	N	6P2a Na	6Q2a K	5B1a Base Sat. %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6N1a Ca	6O1a Mg	8A1	8A MOISTURE AT SATURATION %
	← milliequivalents per 100g. soil →							← milliequivalents per liter →					
0-8	27.8	20.0	6.2		-	0.4	96	0.3	0.1	1.9	1.3		56.9
8-12	26.7	20.7	6.7		0.1	0.3		0.4	0.1	2.7	1.6		59.6
12-16	24.3				0.1	0.2		0.5	-	3.2	1.7		57.5
16-21	15.0				0.1	0.2		0.5	-	2.6	1.6		47.8
21-32	12.8				0.2	0.1		0.6	-	2.0	1.9		51.6
32-40	13.7				0.2	0.2		0.6	-	2.4	2.6		50.3
40-50	13.5				0.2	0.1		0.6	-	2.1	2.8		51.8

a. Few black and dark brown irregular concretions in sand fraction (Mn, Fe?).
b. Few black and dark brown irregular concretions in sand fraction (Mn, Fe?); few $CaCO_3$ concretions in sand fraction.
c. Few $CaCO_3$ concretions in sand fraction.

Soil classification: Udic Haploboroll; fine-loamy, mixed.
Soil: Formdale series.
Soil No.: S57MN-75-1.
Location: NW NE 1/4, Sec. 1, T124N, R23W, Stevens County, Minnesota.
Topography: Gently rolling moraine - sample collected on a 3-percent slope.
Drainage and permeability: Well drained. Runoff is medium. Permeability is moderate.
Present cover: Oat stubble.
Collected by: L. T. Alexander, J. S. Allen, R. F. Dever, A. S. Robertson, August 10, 1957.
Described by: A. S. Robertson, September 3, 1957.

Ap 6085 0 to 8 inches Black (10YR 2/1) moist, heavy loam or light clay loam; friable; cloddy structure; lower boundary is abrupt and smooth.

B21 6086 8 to 12 inches Very dark grayish brown (10YR 3/2) moist, clay loam; friable; moderate medium prisms break to weak fine subangular blocks. Lower boundary is clear and smooth. A few small tongues of Ap material extend into this horizon.

B22 6087 12 to 16 inches Dark brown (10YR 3/3 to 4/3) moist, clay loam; friable; moderate medium prisms break to weak fine subangular blocks. Thin patchy clay skins occur mainly on the vertical faces of the peds. Lower boundary is clear and smooth.

B3ca 6088 16 to 21 inches Brown (10YR 5/3 to 2.5Y 5/3) moist, clay loam, very friable; weak coarse prisms break to weak very fine subangular blocks. Some evidence of thin patchy clay skins on vertical faces of prisms. Lower boundary is clear and smooth. Strong to violent effervescence with dilute HCl.

[redacted]

SOIL CLASSIFICATION Udic Haploboroll; fine-loamy, mixed

SOIL Formdale series LOCATION Stevens County, Minnesota

SOIL No.: S57MN-75-2 LAB. NO. 6092-6099

SOIL SURVEY LABORATORY Lincoln, Nebraska DATE September 3, 1957

GENERAL METHODS 1A, 1B1a, 2A1, 2B

DEPTH INCHES	HORIZON	PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2	TEXTURAL CLASS
0-7	Ap	2.6	3.4	4.3	10.8	8.3	35.5	35.1	31.0	19.2	1	cl
7-12	B21	2.6a	3.1	4.3	10.0	9.0	33.4	37.6	29.8	18.6	2	cl
12-15	B22	2.5b	3.0	3.9	9.2	8.4	34.2	38.8	27.6	20.4	2	cl
15-22	Cca	4.6b	3.9	3.7	8.6	7.9	37.2	34.1	25.1	25.1	11	cl
22-29	Cca2	3.7b	3.9	3.9	8.6	7.8	38.2	33.9	25.3	25.8	9	cl
29-37	C1	3.7b	3.3	3.7	8.7	8.4	40.0	32.2	27.3	26.5	5	cl
37-47	C2	2.9b	3.4	3.8	9.0	8.6	41.2	31.1	28.5	26.7	5	cl
47-60	C3	4.1b	3.3	3.4	8.1	8.3	43.7	29.1	29.6	27.2	7	cl

SATURATED PASTE	pH 8C1a 1:5	1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
7.2	7.3	7.4	3.17	0.284	11		0.5	-				
7.1	7.2	7.2	1.04	0.102	10		0.5	-				
7.5	7.9	8.1	0.84	0.085	10		0.6	4				
8.0	8.6	8.9	0.51	0.056	9		0.5	29				
8.1	8.7	8.9	0.46				0.5	26				
8.1	8.8	8.9	0.36				0.5	26				
8.2	8.9	9.0	0.28				0.5	26				
8.3	8.8	8.9	0.23				0.5	26				

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	H	6P2a Na	5B1a 6Q2a K	Base Sat.	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6N1a Ca	6O1a Mg	8A1	8A MOISTURE AT SATURATION
← milliequivalents per 100g. soil →						%	← milliequivalents per liter →					%
30.1	23.9	7.7		-	0.6		0.3	0.1	3.0	1.8		57.3
25.5	18.2	8.1		0.1	0.3		0.4	0.1	2.0	1.8		54.2
24.7				0.1	0.3		0.4	0.1	2.7	2.1		58.2
14.3				0.1	0.2		0.5	0.1	2.0	1.8		50.8
14.5				0.1	0.1		0.5	-	1.7	2.0		52.1
13.9				0.1	0.1		0.5	-	1.7	2.9		55.0
13.6				0.1	0.1		0.6	-	1.4	2.2		52.8
13.8				0.2	0.2		0.5	0.1	1.0	2.6		52.8

a. Few black and dark brown irregular concretions in sand fraction (Mn, Fe?).
b. Few $CaCO_3$ concretions in sand fraction; few black and dark brown irregular concretions in sand fraction (Mn, Fe?).

Soil classification: Udic Haploboroll; fine-loamy, mixed.
Soil: Formdale series.
Soil No.: S57MN-75-2.
Location: SW NE 1/4 Sec. 13, T125N, R42W, Stevens County, Minnesota.
Topography: Gently rolling to rolling moraine. Sample was collected on a 6-percent slope - north facing.
Drainage and permeability: Well drained shading to moderately well drained. Runoff is medium, permeability is moderate (may be moderately slow in C horizon).
Present cover: Oat stubble.
Collected by: L. T. Alexander, J. S. Allen, R. F. Dever, and A. S. Robertson, August 11, 1957.
Described by: A. S. Robertson.

Ap 6092 0 to 7 inches. Black (10YR 2/1) moist, light clay loam; friable; weak very fine and fine granular structure; lower boundary is abrupt and smooth.

B21 6093 7 to 12 inches. Very dark grayish brown to dark brown (10YR 3/2 to 3/3) moist, clay loam; friable; moderate medium prismatic break to moderate fine subangular blocks; nearly continuous thin clay skins on all ped faces;

tongues of Ap material extend into this horizon. Dark gray wormcasts are common. Lower boundary is clear and wavy.

B22 6094 12 to 15 inches. Dark brown to olive brown (10YR 4/3 to 2.5Y 4/4) moist, clay loam; friable; slightly plastic when wet; moderate to strong medium prisms break to moderate fine and medium blocks; nearly continuous clay skins on all ped faces; lower boundary is clear and smooth. The soil mass does not effervesce with HCl, but there are small spots which do and these are variable in extent. Some tongues of Ap material extend into this horizon. There are also a few dark gray wormcasts.

Cca 6095 15 to 22 inches. Dark grayish brown (10YR 4/2 to 2.5Y 4/2) moist, clay loam; friable; massive; violent reaction to HCl. Lime is segregated in threads and seams and soft concretions. Lower boundary is gradual and wavy.

Cca2 6096 22 to 29 inches. Dark grayish brown (10YR 4/2 to 2.5Y 4/2) moist, clay loam; friable to firm; massive with tendency to weak fine subangular blocks; lime is segregated in threads, seams and soft lime concretions; reacts violently with HCl.

C1 6097 29 to 37 inches. Olive brown and light olive brown (2.5Y 4/4 and 2.5Y 5/4) moist, clay loam; friable to firm; massive or weak fine subangular blocks; lime is generally disseminated but some exists in threads; reacts violently with HCl.

C2 6098 37 to 47 inches. Olive brown (2.5Y 4/4) moist, with a few small faint mottles of light olive brown; clay loam; massive structure but horizontal cleavage is noticeable; friable to firm; lime is generally disseminated but some exists in threads; reacts violently to HCl.

C3 6099 47 to 60 inches. Light olive brown to grayish brown (2.5Y 5/4 to 5/2) moist, clay loam; friable to firm; massive structure but horizontal cleavage is noticeable; lime is generally disseminated but some exists in threads; reacts violently with HCl.

Remarks: This pedon developed in calcareous friable to firm clay loam till of late Wisconsin (Mankato) age. A few stones and small pebbles occurred on the surface and throughout the pedon. Roots were numerous in the A and B horizons but only a few were observed in the C horizons. Bleached sand grains were observed in the A horizon.

SOIL CLASSIFICATION-AQUIC HAPLUDOLL
FINE, MONTMORILLONITIC, MESIC
SERIES - - - - - - -GUCKEEN

SOIL NO - - - - - - S69MN-7-2 COUNTY - - - BLUE EARTH

GENERAL METHODS- - -1A, 1B1B, 2A1, 2B SAMPLE NOS. 69B773-69B779 (A) JULY 1976

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, NTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

69L930-69L933

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B															RATIO
		SAND	SILT	CLAY	FINE CLAY	SAND VCOS	SAND CORS	SAND MEDS	SAND FNES	SAND VFNS	SILT COSI	SILT FNSI	SILT VFSI	FAML TEXT	INTR II	FINE CLAY	NON-CO3-CLAY	8D1 15-BAR
		2-.05	.05-.002	LT .002	LT .0002	2-1	1-.5	.5-.25	.25-.10	.10-.05	.05-.02	.02-.002	.005-.002	SAND 2-.1	.2-.02	CLAY TO	PCT	TO CLAY
CM		PCT LT 2MM																
000-20	AP	12.8	47.7	39.5	23.6	0.4	1.0	1.7	5.1	4.6	10.9	36.8	14.4	8.2	18.9	60		0.45
020-33	A12	11.9	45.7	42.4	25.4	0.6	1.0	1.6	5.0	3.8	9.6	36.1		8.1	16.7	60		0.45
033-56	A3	12.2	44.5	43.3	26.2	0.2	0.8	1.5	4.9	4.8	7.8	36.7	15.2	7.4	15.8	60		0.45
056-79	B1	11.9	44.3	43.8	25.5	0.8	1.0	1.5	4.4	4.2	6.0	38.3	17.3	7.7	13.1	58		0.47
079-99	2B2	21.5	42.3	36.2	19.5	0.8	2.1	2.9	8.5	7.2	9.1	33.2		14.3	22.0	54		0.55
099-127	2C1	24.4	45.9	29.7		1.5	3.1	4.1	9.6	6.1	10.2	35.7		18.3	22.2			0.55
127-152	2C2	29.6	43.9	26.5	8.8	1.9	3.4	4.4	11.4	8.5	11.5	32.4	12.2	21.1	27.2	33		0.57

DEPTH	PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2					BULK DENSITY				WATER CONTENT				CARBONATE		PH	
	VOL. GT 2	WEIGHT GT 75	75-20	20-5	5-2	LT .074	20-2	4A1O 1/3-BAR	4A1H OVEN DRY	4D1 COLE	4B1C 1/10 BAR	4B1C 1/3-BAR	4B2 15-BAR	4C1 WRD	6E1B LT 2	3A1A LT .002	8C1A 1/1 H2O	8C1E 1/2 CACL
CM	PCT	PCT	PCT LT 75				LT20	G/CC	G/CC		PCT	PCT	PCT	CM/CM	PCT	PCT		
000-20	TR	0	0	0	TR	90		1.108					17.9				5.3	
020-33	TR	0	0	0	TR	90		1.19	1.44	.066	38.9	36.7	19.2	0.21			5.5	
033-56	TR	0	0	0	TR	91		1.16	1.54	.099	37.8	38.9	19.7	0.22	0.6C		5.6	
056-79	TR	0	0	0	TR	91		1.23	1.62	.096	35.2	33.7	20.8	0.16			5.7	
079-99	TR	0	TR	TR	1	82		1.308					20.0				6.8	
099-127	TR	0	TR	TR	TR	80		1.37	1.48	.027	31.3	29.5	16.3	0.18		15	7.8	
127-152	TR	0	TR	TR	1	74		1.408					15.2			12	7.8	

DEPTH	ORGANIC MATTER 6A1A ORGN CARB	6B1A NITG	C/N	IRON 6C2B EXT FE	PHOS 6S1A TOTL	EXTRACTABLE BASES 5B4A- 6N2E CA	6O2D MG	6P2B NA	6Q2B K	SUM	ACTY 6H2A BACL TEA	AL 6G1D KCL EXT	(CAT EXCH) 5A3A EXTB ACTY	5A6A NHAC	RATIO 8D1 NHAC TO	RATIO 8D3 CA TO	CA SAT NHAC	(BASE SAT) 5C3 EXTB ACTY	5C1 NHAC
CM	PCT	PCT		PCT	PCT	MEQ / 100 G									CLAY	MG	PCT	PCT	PCT
000-20	3.250	0.276	12																
020-33	3.30	0.274	12																
033-56	2.31	0.210	11																
056-79	0.92	0.109	8																
079-99	0.53																		
099-127	0.26																		
127-152	0.14																		

DEPTH	SATURATED PASTE 8E1 REST OHM-	8C1B PH	8A H2O	NA 5D2 ESP	NA 5E SAR	SALT 8D5 TOTL SOLU	GYP 6F1A	SATURATION EXTRACT 8A1- 8A1A EC	6N1B CA	6O1B MG	6P1A NA	6Q1A K	6I1A CO3	6J1A HCO3	6K1A CL	6L1A SO4	6M1A NO3	ATTERBERG 4F1 LQID LMIT	4F2 PLST INDX
CM	CM		PCT	PCT		PPM	PCT	MMHOS/CM	MEQ / LITER									PCT	
000-20																			
020-33																			
033-56																			
056-79																			
079-99	2000	6.8																	
099-127	2000	7.5																	
127-152	2000	7.5																	

ANALYSES BY MINNESOTA AGRICULTURAL EXPERIMENT STATION, ST PAUL, MN. MINERALOGY BY X-RAY ANALYSIS. TOTAL PHOSPHORUS BY NITRIC-PERCHLORIC DIGESTION. AVAILABLE PHOSPHORUS BY BRAY'S NO 1 EXTRACTANT.

DEPTH	MINERALOGY MONT	VERM	ILLITE	KAOL	QUARTZ (PCT LT .002MM)	TOTAL P	AVAIL P (LBS/A)
000-20						1296	27
020-33							27
033-56						1028	6
056-79						730	1
079-99							2
099-127						844	1
127-152							1

(A) BULK DENSITY AND WATER CONTENT ANALYSES BY THE SOIL SURVEY INVESTIGATIONS UNIT, LINCOLN, NE. UNLESS OTHERWISE INDICATED REMAINING ANALYSES BY THE SOIL SURVEY INVESTIGATIONS UNIT, BELTSVILLE, MD.

(B) ESTIMATED.

(C) MICRO-PENETRATION RESISTANCE - A ROD 0.6 CM DIA IS SLOWLY PUSHED INTO BULK DENSITY CLOD, EQUILIBRATED AT 1/10-BAR, A DISTANCE OF 0.6 CM USING A POCKET PENETROMETER. UNITS ARE FORCE (KG) AND NOT ESTIMATES OF UNCONFINED COMPRESSIVE STRENGTH.

(D) ORGANIC CARBON IS 22 KG/M SQ TO A DEPTH OF 1 M (6A).

Pedon classification: Aquic Hapludoll; fine, montmorillonitic, mesic.
Series classification: Same.
Soil: Cuckeen series.
Soil No.: S69MN-7-2.
Location: Blue Earth County, Minnesota; SE1/4 of SW1/4, Sec. 23, T. 105 N., R. 28 W. (Shelby Twp.); about 240 feet east and 1,000 feet north of southwest section corner. About 94 deg. 10 min. west longitude and 43 deg. 53 min. north latitude.
Climate: Humid continental. Some characteristics of temperature in deg. F. are: annual normal - 26, winter normal - 17, summer normal - 71; some characteristics of precipitation in inches are: annual normal - 28, May through September - 18, normal annual snowfall - 40.
Parent material: Moderately shallow, fine textured lacustrine sediments over grayish, calcareous, loam till (New Ulm) Des Moines Lobe, Late Wisconsin age.
Physiography: Central lowlands; glacial Lake Minnesota Plain in the Blue Earth Till Plain of H. E. Wright (1972).
Landscape setting: About 3 percent slightly convex east facing slope. General topography is nearly level to gently undulating. Relative relief is about 10 feet in the immediate area. Elevation is about 1,045 feet. Major associated soils on the landscape near this site are of the Lara, Marna, and Kamrar series.
Vegetation: Recently plowed oat field; native vegetation was tall grass prairie.
Drainage: Lower moderately well drained.
Erosion: Slight.
Permeability: Moderately slow in upper part, moderate in the glacial till.
Described by: R. J. Edwards and H. R. Finney on October 20, 1969.
Sampled by: L. Shields, R. J. Edwards, J. J. Murray, J. F. Cummins, and H. R. Finney on October 20, 1969.

Ap 69B773 0 to 20 cm (0 to 8 inches). Black (10YR 2/1) heavy silty clay loam; weak very fine subangular blocky structure; friable, plastic and sticky; common roots; abrupt smooth boundary.

A12 69B774 20 to 33 cm (8 to 13 inches). Black (10YR 2/1) silty clay or heavy silty clay loam; very dark gray (10YR 3/1) rubbed; moderate very fine and fine angular and subangular blocky structure; friable, plastic and sticky; common roots; clear smooth boundary.

A3 69B775 33 to 56 cm (13 to 22 inches). Very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2) silty clay, black (10YR 2/1) ped coatings; moderate very fine and fine angular and sub-

B1 69B776 56 to 79 cm (22 to 31 inches). Dark grayish brown (2.5Y 4/3) silty clay, dark grayish brown (10YR 4/2) and very dark grayish brown (10YR 3/2) ped coatings; moderate fine and medium prismatic structure parting to moderate fine and medium angular and subangular blocky structure; friable, plastic and sticky; common black (10YR 2/1) wormcasts; about 1 percent coarse fragments; clear smooth boundary.

IIB2 69B777 79 to 99 cm (31 to 39 inches). Dark grayish brown (2.5Y 4/2) clay loam; few fine faint grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/4) mottles; weak to moderate fine and medium prismatic structure parting to weak fine and medium subangular blocky structure; friable, slightly plastic and sticky; about 5 percent coarse fragments; clear smooth boundary.

IIC1 69B778 99 to 127 cm (39 to 50 inches). Grayish brown (2.5Y 5/2) light clay loam; many medium prominent light olive brown (2.5Y 5/4) mottles; weak fine and medium subangular blocky structure with some weak platy primary structure; friable, slightly plastic and sticky; about 5 percent coarse fragments; about 5 percent soft lime masses; strongly effervescent; clear smooth boundary.

IIC2 69B779 127 to 152 cm (50 to 60 inches). Light olive brown (2.5Y 5/4) loam; many coarse prom-

SOIL CLASSIFICATION: Typic Eutroboralf; fine, mixed

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL Hibbing series SOIL Nos. S64Minn-69-2 LOCATION Saint Louis County, Minnesota

SOIL SURVEY LABORATORY Lincoln, Nebraska LAB. Nos. 19818-19828 June 1968

GENERAL METHODS: 1A, 1B1b, 2A1, 2B

Depth (in.)	Horizon	Size class and particle diameter (mm) 3A1 — Total: Sand (2–0.05)	Total: Silt (0.05–0.002)	Total: Clay (< 0.002)	Sand: Very coarse (2–1)	Sand: Coarse (1–0.5)	Sand: Medium (0.5–0.25)	Sand: Fine (0.25–0.1)	Sand: Very fine (0.1–0.05)	Silt: 0.05–0.02	Silt: Int. III (0.02–0.002)	Int. II (0.2–0.02)	(2–0.1)	<0.074	0.005–0.002	Coarse fragments 2A2: 3B2 Vol. 19-2	3B1 Wt. 19-2
		Pct. of < 2 mm														Pct. of <2 mm	
1½–0	A0																tr
0–2½	A1	36.8	44.4	18.8	2.2	6.4	6.8	13.1	8.3	12.9	31.5	28.5	28.5	67.6	11.2		2
2½–5	A2	33.0	46.0	21.0	3.2	5.8	5.6	10.7	7.7	13.8	32.2	27.5	25.3	71.3	11.9	3	5
5–7	B2	35.9	45.5	18.6	3.9	6.6	6.0	11.3	8.1	13.0	32.5	27.4	27.8	68.7	13.0		9
7–8	A'2	33.9	48.4	17.7	3.4	5.9	5.5	11.0	8.1	13.0	35.4	27.2	25.8	70.7	14.3		7
8–11	A'2&B'2	22.1	40.4	37.5	2.1	3.7	3.6	7.2	5.5	9.5	30.9	19.0	16.6	81.2	13.3	2	4
11–16	B'21	16.7	33.8	49.5	2.0	2.7	2.7	5.3	4.0	7.4	26.4	14.3	12.7	85.6	13.3	1	2
16–22	B'22	17.0	38.2	44.8	1.3	3.0	2.7	5.4	4.6	8.5	29.7	16.1	12.4		13.8	2	4
22–34	B'23	18.2	38.6	43.2	2.2	3.0	2.9	5.7	4.4	9.0	29.6	16.6	13.8	84.4	15.5	2	3
34–48	C1	18.6	38.4	43.0	1.5	3.6	3.1	5.9	4.5	8.9	29.5	16.7	14.1	84.1	13.9	5	8
48–60+	C2	16.5	39.6	43.9	1.6	2.9	2.6	5.2	4.2	9.2	30.4	16.3	12.3	86.1	15.2	1	2

Depth (in.)	6A1a Organic carbon Pct.	6B1a Nitrogen Pct.	C/N		6E2a Carbonate as $CaCO_3$ Pct.	6C2a Ext. Iron as Fe Pct.	Bulk density: 4A1a Field-State g/cc	4A1d 1/3-Bar g/cc	4A1b Air-Dry g/cc	4D1 COLE	Water content: 4B4 Field-State Pct.	4B1c 1/3-Bar Pct.	4B2 15-Bar Pct.	4C1 1/3-to 15-Bar in./in.	3A1b Fine Clay <0.002 mm. Pct.	pH		8C1a (1:1)
1½–0	20.9																	
0–2½	4.00	0.166	24			1.1							9.3					4.4
2½–5	1.71	0.083	21			1.0	1.60a	1.58a	1.59a	0.003a	12.0a	14.6a	8.2	0.10				4.6
5–7	0.61	0.043	14			0.9							5.6	0.14				4.8
7–8	0.39	0.028	14			0.9							4.8					4.9
8–11	0.35	0.033	11			1.3	1.77	1.77	1.80	0.007	15.6	15.2	11.0	0.07				4.9
11–16	0.32	0.030	11			1.5	1.68	1.61	1.78	0.036	17.1	19.9	14.6	0.09				5.1
16–22	0.08				-(s)	1.5	1.74	1.62	1.80	0.036	15.9	19.8	13.8	0.10	11.0			6.9
22–34	0.10				-(s)	1.5	1.80	1.69	1.83	0.028	15.3	18.8	15.2	0.06				7.4
34–48	0.10				-(s)	1.4	1.76	1.64	1.80	0.032	16.7	20.7	15.1	0.09				7.6
48–60	0.08				-(s)	1.4	1.74	1.62	1.75	0.024	17.3	20.9	15.5	0.09				7.9

Depth (in.)	Extractable bases 5B1a: 6N2a Ca	6O2a Mg	6P2a Na	6Q2a K	Sum	6H1a Ext. Acidity	Cat.Exch.Cap.: 5A3a Sum Cations	5A1a NH_4OAc	6G1d KCl-Ext. Al	8D3 Ca/Mg	Base saturation: 5C3 Sum Cations Pct.	5C1 NH_4OAc CEC Pct.
	meq/100 g											
1½–0												
0–2½	2.3	1.3	0.1	0.3	4.0	21.5	25.5	18.7	4.6	1.8	16	21
2½–5	1.1	0.9	0.1	0.2	2.3	16.5	18.8	13.0	4.6		12	18
5–7	0.9	1.0	0.1	0.1	2.1	10.7	12.8	8.3	2.8		16	25
7–8	1.1	1.1	0.1	0.1	2.4	8.5	10.9	7.0	2.0	1.0	22	34
8–11	5.0	4.8	0.2	0.3	10.3	12.6	22.9	16.7	2.5	1.0	45	62
11–16	10.0	9.4	0.5	0.4	20.3	12.2	32.5	25.8	2.0	1.1	62	79
16–22	12.1	10.8	0.6	0.5	24.0	4.5	28.5	22.9		1.1	84	105
22–34	11.8	10.4	0.7	0.4	23.3			21.8		1.1		107
34–48	11.6	10.2	0.8	0.4	23.0			20.9		1.1		110
48–60	11.3	10.1	0.9	0.4	22.7			20.5		1.1		111

Depth (in.)	Ratios to Clay 8D1: NH_4OAc CEC	Ext. Iron	15-Bar Water
1½–0			
0–2½	0.99	0.06	0.49
2½–5	0.62	0.05	0.39
5–7	0.45	0.05	0.30
7–8	0.40	0.05	0.27
8–11	0.45	0.03	0.29
11–16	0.52	0.03	0.29
16–22	0.51	0.03	0.31
22–34	0.50	0.03	0.35
34–48	0.49	0.03	0.35
48–60	0.47	0.03	0.35

a. 2½ to 7 inches.

Soil classification: Typic Eutroboralf; fine, mixed.
Soil: Hibbing series.
Soil No.: S64MN-69-2.
Location: St. Louis County, Minnesota. T58N, R18W, Section 29. SW¼. Approximately 700 feet northwest from south side of section 29 along county road No. 101 and 330 feet northeast along woods trail.
Vegetation and use: Mixed stand of balsam fir, white spruce, birch and aspen. Woodland.
Slope and land form: Gently sloping (3 percent). Northwest aspect. In an area of rolling moraine.
Drainage and permeability: Well drained with medium runoff and moderately slow internal drainage; moderately slow permeability.
Parent material: Calcareous red clay till.
Samples collected by: R. H. Jordan, D. McMurtry, F. M. Scilley, R. S. Farnham, R. Lewis, August 27, 1964.
Profile described by: R. Lewis, F. M. Scilley and R. S. Farnham, August 27, 1964. Colors are for the moist soil.

Horizon and Lincoln Lab. No.	
A0 19818	1½ to 0 inches. Leaves, roots and partly decomposed leaf mold.
A1 19819	0 to 2½ inches. Dark gray (10YR4/1) silt loam; weak fine granular structure; friable when moist; many roots; some mixing by worms; numerous bleached sand grains; clear smooth boundary.
A2 19820	2½ to 5 inches. Grayish brown (10YR5/2) silt loam; weak to moderate thin platy structure; friable when moist; numerous roots; much mixing of dark surface; clear smooth boundary.
B2 19821	5 to 7 inches. Brown (10YR5/3) silt loam; weak thin platy structure; friable when moist; numerous roots; porous; abrupt wavy boundary.
A'2 19822	7 to 8 inches. Brown (7.5YR5/2) silt loam; moderate thin platy structure; friable when moist; numerous roots; porous; abrupt smooth boundary.
A'2 & B'2 19823	8 to 11 inches. Pinkish gray (7.5YR6/2) and reddish brown (5YR5/3) silt loam and silty clay; moderate fine to medium subangular blocky structure; firm when moist, slightly plastic when wet; common roots; clear wavy boundary.
B'21 19824	11 to 16 inches. Reddish brown (5YR4/3) clay; strong fine to medium angular blocky structure; firm when moist, plastic when wet; common roots; thin patchy clay flows on some vertical ped faces; gradual smooth boundary.
B'22 19825	16 to 22 inches. Reddish brown (5YR4/3) clay; strong fine to medium angular blocky structure; very firm when moist, plastic when wet; moderately thick clay flows on both vertical and horizontal ped faces; gradual smooth boundary.
B'23 19826	22 to 34 inches. Reddish brown (5YR4/3) clay; weak medium prismatic structure breaking to strong fine to medium angular blocky structure; very firm when moist, plastic when wet; few roots; moderately thick clay flows on vertical ped faces and along vertical cleavage planes; gradual smooth boundary.
C1 19827	34 to 48 inches. Reddish brown (5YR4/3) clay; weak medium prismatic structure breaks to moderate fine to medium angular blocky structure; very firm when moist, plastic when wet; very few roots; slight effervescence with acid; thin clay flows in pores; gradual smooth boundary.
C2 19828	48 to 60+ inches. Reddish brown (5YR5/3) clay; massive to weak fine angular blocky structure; very firm when moist, plastic when wet; few black coatings in pores and root channels; weak effervescence with acid.

Remarks: Nearly dry when sampled.

Soil temperatures:

Depth (inches)	Temperature
20	12° C.
30	12° C.
40	10° C.
60	10° C.

Mineralogy (Methods 7A2 and 7B1). The clay contains mica, feldspar, amphibole, kaolinite, montmorillonite, quartz, vermiculite and chlorite in decreasing order of abundance. All are well crystallized except the montmorillonite which is fairly well crystallized. The first six components are present in moderate amounts. The vermiculite and chlorite are present in small amounts together with interstratified chlorite-vermiculite. Mineralogy is mixed. Quartz dominates the fine silt, but moderate amounts of well-crystallized kaolinite, feldspar, and mica are present with lesser amounts of chlorite, vermiculite, and montmorillonite. Some interstratified chlorite-vermiculite is

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL Hibbing taxadjunct SOIL Nos. S64Minn-69-1 LOCATION Saint Louis County, Minnesota

SOIL SURVEY LABORATORY Lincoln, Nebraska LAB. Nos. 19807-19817 June 1968

GENERAL METHODS: 1A, 1B1b, 2A1, 2B

Depth (In.)	Horizon	Size class and particle diameter (mm) 3A1 — Total: Sand (2–0.05)	Total: Silt (0.05–0.002)	Total: Clay (< 0.002)	Sand: Very coarse (2–1)	Sand: Coarse (1–0.5)	Sand: Medium (0.5–0.25)	Sand: Fine (0.25–0.1)	Sand: Very fine (0.1–0.05)	Silt: 0.05–0.02	Silt: Int. III (0.02–0.002)	Int. II (0.2–0.02)	(2–0.1)	<0.074	0.005–0.002	Coarse fragments 2A2: 3B2 Vol. 19-2	3B1 Wt. 19-2	
		← Pct. of < 2 mm →														← Pct. of < 19 →		
2-0	A0																tr	
0-5	A21	35.0	55.1	9.9	2.3	5.8	5.7	10.1	11.1	26.8	28.3	43.2	23.9	73.1	10.1	4	7	
5-7	B2	40.3	48.0	11.7	2.5	5.5	6.4	12.8	13.1	24.5	23.5	44.4	27.2	68.8	11.9		4	
7-9	A'2	36.1	45.9	18.0	2.6	5.3	6.0	12.1	10.1	16.8	29.1	33.5	26.0	70.2	10.7		7	
9-14	A'2&B'2	29.4	37.6	33.0	3.0	5.0	4.9	9.8	6.7	10.9	26.7	22.9	22.7	74.5	10.4	4	7	
14-21	B'21	26.9	29.4	43.7	2.7	4.9	4.5	9.0	5.8	8.1	21.3	18.7	21.1	76.3	8.5	1	3	
21-30	B'22	22.3	35.0	42.7	1.8	4.2	3.9	7.4	5.0	8.4	26.6	17.5	17.3		12.1	3	5	
30-38	B'3	27.3	35.1	37.6	2.0	4.8	4.9	9.6	6.0	9.3	25.8	20.5	21.3	76.0	11.3	3	5	
38-48	C1	24.0	36.0	40.0	2.4	4.4	4.2	7.9	5.1	8.4	27.6	17.7	18.9	78.9	11.6	3	5	
48-60	C2	23.3	36.6	40.1	1.9	4.5	4.1	7.6	5.2	8.8	27.8	18.2	18.1	79.7	12.8	4	6	
60-65+	C3	23.7	37.1	39.2	2.5	4.4	4.2	7.5	5.1	9.0	28.1	18.1	18.6	79.3	13.1	2	4	

Depth (In.)	6A1a Organic carbon	6B1a Nitrogen	C/N		6E2a Carbonate as $CaCO_3$	6C2a Ext. Iron as Fe	Bulk density: 4A1a Field-State	4A1d 1/3-Bar	4A1b Air-Dry	4D1 COLE	Water content: 4B4 Field-State	4B1c 1/3-Bar	4B2 15-Bar	4C1 1/3- to 15-Bar		pH: 8C1b Sat. Paste		8C1a (1:1)
	Pct.	Pct.			Pct.	Pct.	g/cc	g/cc	g/cc		Pct.	Pct.	Pct.	in./in.				
2-0	23.7																	
0-5	0.64	0.059	11			0.8	1.66	1.64[a]	1.64	-	10.5	16.0[b]	3.7	0.19[c]				4.7
5-7	0.37					0.6							4.6					4.9
7-9	0.25					0.7							5.7					5.0
9-14	0.32					1.0	1.84	1.81	1.85	0.007	14.5	15.3	10.5	0.09				4.9
14-21	0.31					1.3	1.65	1.50	1.75	0.051	18.1	24.3	13.5	0.16				4.9
21-30	0.18					1.4	1.78	1.66	1.84	0.035	15.3	18.9	12.4	0.11				5.5
30-38	0.11				-(s)	1.3	1.81	1.71	1.83	0.023	13.8	17.2	12.7	0.08				6.9
38-48	0.12				-(s)	1.3	1.77	1.67	1.80	0.023	15.8	19.0	14.1	0.08		6.5		7.5
48-60	0.09				-(s)	1.3	1.76	1.69	1.80	0.019	15.9	18.6	14.1	0.08				7.6
60-65+	0.12				-(s)	1.3							14.3					7.9

Depth (In.)	Extractable bases 5B1a: 6N2a Ca	6O2a Mg	6P2a Na	6Q2a K	Sum	6H1a Ext. Acidity	Cat. Exch. Cap.: 5A3a Sum Cations	5A1a NH_4OAc	6G1d KCl-Ext. Al			8E1 Resistivity	8B1a Elec. Cond.	8B Water at Sat.	8D5 Est. Total salt in soil	8D3 Ca/Mg	Base saturation: 5C3 Sum Cations	5C1 NH_4OAc CEC
	← meq/100 g →											ohms-cm	mmhos/cm	Pct.	ppm.		Pct.	Pct.
2-0																		
0-5	1.2	0.5	tr	0.4	2.1	7.7	9.8	6.7	1.4								21	31
5-7	1.1	0.7	0.1	0.1	2.0	7.4	9.4	6.5	1.9								21	31
7-9	1.8	1.3	0.1	0.1	3.3	8.1	11.4	8.1	2.4							1.4	29	41
9-14	4.6	4.1	0.3	0.3	9.3	11.0	20.3	15.1	2.8							1.1	46	62
14-21	8.7	7.7	0.5	0.4	17.3	12.2	29.5	22.9	2.5							1.1	59	76
21-30	10.4	8.4	0.5	0.4	19.7	7.5	27.2	21.3	0.8							1.2	72	92
30-38	11.4	8.5	0.5	0.3	20.7	3.8	24.5	19.4								1.3	84	107
38-48	11.7	9.2	0.6	0.3	21.8			19.6				3100	0.30	38.5	190	1.3		111
48-60	11.4	8.2	0.6	0.4	20.6			18.8								1.4		110
60-65+	11.1	7.8	0.6	0.4	19.9			17.9								1.4		111

Depth (In.)	Ratios to Clay 8D1: NH_4OAc CEC	Ext. Iron	15-Bar Water
2-0			
0-5	0.67	0.08	0.37
5-7	0.56	0.05	0.39
7-9	0.45	0.04	0.32
9-14	0.46	0.03	0.32
14-21	0.52	0.03	0.31
21-30	0.50	0.03	0.29
30-38	0.52	0.03	0.34
38-48	0.49	0.03	0.35
48-60	0.47	0.03	0.35
60-65+	0.46	0.03	0.36

a. 1/10-bar (Method 4A1g).
b. 1/10- to 15-bar (Method 4C2).
c. 1/10-bar (Method 4B1c).

Pedon classification: Eutric Glossoboralf; fine, mixed.
Series classification: Typic Eutroboralfs; fine, mixed.
Soil: Hibbing taxadjunct.
Soil No: S64 MN-69-1.
Location: St. Louis County, Minnesota. T57N, R18W, Section 6, SE¼, 980 feet west and 180 feet north of SE corner.
Vegetation and use: Jack pine and white spruce grove in corner of pasture. Understory is mainly bluegrass.
Slope and land form: Very gently sloping (2 percent). Southwest aspect. In an area of gently undulating ground moraine.
Drainage and permeability: Well drained with medium runoff and moderately slow internal drainage. Moderately slow permeability.
Parent material: Calcareous red clay till.
Samples collected by: R. H. Jordan, D. McMurtry, F. M. Scilley, R. S. Farnham, R. Lewis, August 27, 1964.
Profile described by: R. Lewis, F. M. Scilley and R. S. Farnham, August 27, 1964. Colors are for the moist soil.

Horizon and Lincoln Lab. No.	
AO 19807	2 to 0 inches. Undecomposed leaves, roots and twigs; abrupt smooth boundary.
A21 19808	0 to 5 inches. Grayish brown (10YR5/2) silt loam; moderate thin to medium platy structure; friable when moist; many roots; abrupt wavy boundary.
B2 19809	5 to 7 inches. Brown (10YR5/3) silt loam; weak very thin platy structure; friable when moist; numerous roots; abrupt smooth boundary.
A'2 19810	7 to 9 inches. Light brownish gray (10YR6/2) silt loam; moderate thin platy; friable when moist; numerous roots; abrupt wavy boundary.
A'2 & B'2 19811	9 to 14 inches. Pale brown (10YR6/3) and reddish brown (5YR4/4) silt loam and silty clay; vertical cleavage gives the appearance of weak coarse prismatic structure which breaks to moderate medium subangular blocky structure; firm when moist; common roots; clear wavy boundary.
B'21 19812	14 to 21 inches. Reddish brown (5YR4/4) clay; vertical cleavage gives the appearance of weak coarse prismatic structure which breaks to strong fine and medium angular blocky structure; plastic when wet; firm when moist; few roots; gradual smooth boundary.
B'22 19813	21 to 30 inches. Reddish brown (5YR4/4) clay; strong fine angular blocky structure with vertical cleavage; plastic when wet; very firm when moist; few roots; gradual smooth boundary.
B'3 19814	30 to 38 inches. Reddish brown (5YR5/3) clay; weak fine to medium angular blocky structure with vertical cleavage; dark colored organic films or vertical faces of some peds; very firm when moist; plastic when wet; very few roots; gradual smooth boundary.
C1 19815	38 to 48 inches. Reddish brown (5YR5/3) clay; massive with vertical cleavage grading to weak fine angular blocky structure; dark colored organic films on vertical faces of some peds; very firm when moist; plastic when wet; few roots; diffuse smooth boundary.
C2 19816	48 to 60 inches. Reddish brown (5YR5/3) to brown (7.5YR5/4) clay; massive with vertical cleavage grading to weak fine angular blocky structure; very firm when moist; plastic when wet; gradual irregular boundary.
C3 19817	60 to 65+ inches. Reddish brown (5YR5/3 to brown (7.5YR5/4) clay; massive to weak angular blocky structure; very firm when moist; plastic when wet; slight effervescence.

Remarks: Nearly dry when sampled.

Soil temperatures:

Depth (inches)	Temperature
20	11° C.
30	11° C.
40	11° C.
65	10° C.

SOIL CLASSIFICATION-AQUOLLIC HAPLUDALF U. S. DEPARTMENT OF AGRICULTURE

[redacted]

SOIL NO - - - - - - S70MN-20-2 COUNTY - - - DODGE

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 70L1068-70L1078

DEPTH CM	HORIZON	SAND 2-.05	SILT .05-.002	CLAY LT .002	FINE CLAY LT .0002	VCOS 2-1	CORS 1-.5	MEDS .5-.25	FNES .25-.10	VFNS .10-.05	COSI .05-.02	FNSI .02-.002	VFSI .005-.002	FAML TEXT SAND 2-.1	INTR II .2-.02	FINE CLAY TO CLAY PCT	NON-CO3-CLAY PCT	RATIO 8D1 15-BAR TO CLAY
		(- - - - PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B - - - - PCT LT 2MM - - - -)																
000-22	AP	16.7	58.6	24.7	14.4	.3	3.0	4.2	5.7	3.5	30.1	28.5	7.3	13.2	36.5	58	25	.47
022-32	B1	15.4	56.6	28.0	15.7	.7	2.7	3.3	5.0	3.7	23.9	32.7	7.1	11.7	30.2	56	28	.43
032-43	B21	21.2	50.4	28.4	15.4	1.5	3.5	4.1	6.9	5.2	22.6	27.8	6.1	16.0	31.4	54	28	.42
043-59	2B22t	39.5	34.1	26.4	14.6	3.2	6.5	7.4	13.3	9.1	14.3	19.8	6.0	30.4	30.4	55	26	.39
059-87	2B23t	43.9	30.6	25.5	12.4	2.7	7.3	8.1	15.0	10.8	11.7	18.9	5.8	33.1	30.6	49	26	.38
087-127	2B24t	44.3	30.5	25.2	11.5	2.9	7.3	7.9	15.3	10.9	12.2	18.3	6.1	33.4	31.3	46	25	.40
127-168	2C1	43.8	33.2	23.0	9.2	4.4	7.3	7.4	14.3	10.4	13.0	20.2	6.7	33.4	31.2	40	23	.42
168-225	2C2	44.5	32.9	22.6	8.2	4.6	8.0	7.5	14.2	10.2	13.0	19.9	6.5	34.3	30.8	36	23	.43
225-265	2C3	43.2	34.5	22.3	8.3	3.4	7.2	8.0	14.6	10.0	13.7	20.8	7.0	33.2	31.6	37	22	.44
265-310	2C4	45.4	34.8	19.8	8.6	4.5	7.8	8.2	14.9	10.0	15.3	19.5	5.9	35.4	33.2	43	20	.45
310-360	2C5	49.1	33.4	17.5	9.1	4.7	7.6	9.1	16.9	10.8	15.8	17.6	4.9	38.3	35.5	52	18	.46

DEPTH CM	(PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2) VOL. GT 2 PCT	WEIGHT GT 75 PCT	75-20 (PCT LT 75)	20-5 (PCT LT 75)	5-2 (PCT LT 75)	LT .074 (PCT LT 75)	20-2 PCT LT20	BULK DENSITY 4A1D 1/3-BAR G/CC	4A1H OVEN DRY G/CC	4D1 COLE	WATER CONTENT 4B1C 1/10 BAR PCT	4B1C 1/3-BAR PCT	4B2 15-BAR PCT	4C1 WRD CM/CM		CARBONATE 6E1B LT 2 PCT	3A1A LT .002 PCT	PH 8C1A 1/1 H2O	8C1E 1/2 CACL
000-22	TR	0	0	TR	TR	85	TR	1.42	1.59	.039	28.4	27.3	11.6	.23	3.58			6.6	6.7
022-32	TR	0	0	TR	TR	87	TR	1.47	1.63	.036	27.4	25.7	12.0	.21	2.08			6.1	5.9
032-43	TR	0	0	TR	TR	82	TR	1.50A					11.8					5.2	4.7
043-59	TR	0	0	TR	TR	66	TR	1.53	1.70	.036	21.0	19.1	10.4	.13	2.1B			4.7	4.2
059-87	TR	0	TR	TR	1	61	1	1.63	1.82	.036	17.0	15.5	9.8	.09	3.6B			4.8	4.4
087-127	1	0	0	TR	1	61	1	1.72	1.86	.026	16.8	15.7	10.1	.10	3.0B			5.5	5.2
127-168	3	0	TR	2	2	60	4	1.70A					9.7			6	0	7.8	7.6
168-225	2	0	TR	1	2	60	3	1.82	1.94	.022	16.2	15.6	9.7	.11		8	0	8.0	7.7
225-265	3	0	0	1	3	60	4	1.85	2.02	.029	16.2	15.2	9.8	.10	4.1B	10	0	8.1	7.8
265-310		0	TR	3	4	56	7						9.0			13	TR	7.9	7.6
310-360		0	0	3	4	53	7						8.0			14	0	8.2	7.8

DEPTH CM	ORGANIC MATTER 6A1A ORGN CARB PCT	6B1A NITG PCT	C/N	IRON 6C2B EXT FE PCT	PHOS TOTL PCT	EXTRACTABLE BASES 5B4A 6N2E CA	6O2D MG	6P2B NA	6Q2B K	SUM EXTB (MEQ / 100 G)	ACTY 6H1A BACL TEA	AL 6G1E KCL EXT	CAT EXCH 5A3A EXTB ACTY	5A6A NHAC	RATIO 8D1 NHAC TO CLAY	RATIO 8D3 CA TO MG	CA 5F1 SAT NHAC PCT	BASE SAT 5C3 EXTB ACTY PCT	5C1 NHAC PCT
000-22	2.26C	.206	11	0.9		16.7	5.3	0.2	0.5	22.7	6.2		28.9	23.5	0.95	3.1	71	79	97
022-32	0.63	.078	8	1.1		13.2	4.4	0.2	0.4	18.2	6.1		24.3	19.2	0.69	3.0	69	75	95
032-43	0.32	.047	7	1.3		11.2	3.6	0.2	0.5	15.5	8.2	0.8	23.7	19.1	0.67	3.1	59	65	81
043-59	0.19	.029	7	1.7		7.6	2.7	0.2	0.3	10.8	8.0	1.6	18.8	15.4	0.58	2.8	49	57	70
059-87	0.14			2.0		7.3	2.4	0.2	0.3	10.2	6.2	1.0	16.4	13.7	0.54	3.0	53	62	74
087-127	0.08			2.0		11.1	2.7	0.2	0.3	14.3	3.3	0.1	17.6	13.6	0.54	4.1	82	81	105
127-168	0.07			1.7		15.9D	2.4D	0.2	0.3	18.8				11.5	0.50				
168-225	0.04			1.6		15.4D	2.4D	0.2	0.3	18.3				11.1	0.49				
225-265	0.03			1.4		14.9D	2.3D	0.2	0.3	17.7				10.0	0.45				
265-310	0.03			1.2		13.9D	2.0D	0.2	0.3	16.4				8.9	0.45				
310-360	0.02			0.9		13.3D	1.9D	0.1	0.3	15.6				8.0	0.46				

Pedon classification: Aquollic Hapludalf; fine-loamy, mixed, mesic.
Series classification: Same.
Soil: Kasson series.
Soil No.: S70 MN-20-2.
Location: Dodge County, Minnesota; about 4 miles north of Hayfield; about 950 feet east and 450 feet south of the northwest corner of the SW1/4 of NW1/4, Sec. 35, T. 106 N., R. 17 W. About 92 deg. 50 min. west longitude and 43 deg. 57 min. north latitude.
Climate: Humid continental. Some features of precipitation in inches: annual normal - 29, May through September - 19, annual normal snowfall - 40. Some features of temperature in deg. F.; annual normal - 45, summer normal - 70, winter normal - 18.
Parent material: Loamy mantle (loess?) over loamy calcareous Kansan(?) till with a thin intervening stone line.
Physiography: Central lowlands: Iowan Erosion Surface (Ruhe); Rochester Till Plain (Wright); Kenyon-Taopi Plain, silty, undulating (MN Soil Atlas).
Landscape setting: Site has a slightly convex 3 percent slope on a summit. Topography in immediate vicinity is gently rolling. Relative relief in the immediate vicinity is about 20 feet. Elevation is about 1,320 feet. Major soils in the area are of the Kasson, Skyberg, and Racine series.
Vegetation: Corn field. Native vegetation was tall grass prairie or savanna.
Drainage: Moderately well drained.
Erosion: Slight.
Moisture: Moist to wet; area recently had prolonged heavy rains. Water entered the pit at the contact of the two sediments and between prism faces.
Root distribution: Common to 23 inches, few below.
Permeability: Moderate in upper part of solum grading to slow or moderately slow in the IIC horizon.
Described by: J. F. Cummins on October 20, 1970.
Sampled by: R. B. Grossman, E. R. Gross, and J. F. Cummins on October 20, 1970.

Ap 70L1068 0 to 22 cm (0 to 8 inches) Very dark gray (10YR 3/1) (10YR 4/1 to 5/1, dry) silt loam; weak fine granular and weak fine subangular blocky structure; friable; many fine pores; abrupt smooth boundary.

B1 70L1069 22 to 32 cm (8 to 13 inches) Dark brown (10YR 4/3) silt loam, dark grayish brown (10YR 4/2) (10YR 5/3, dry) ped faces; weak thin platy structure parting to weak fine subangular blocky structure; friable; many fine pores; abrupt smooth boundary.

B21 70L1070 32 to 43 cm (13 to 17 inches) Brown (10YR 4/3) silt loam, dark grayish brown (10YR 4/2) ped faces; few fine faint yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; friable; many fine pores; abrupt smooth boundary.

IIB22t 70L1071 43 to 59 cm (17 to 23 inches) Brown (10YR 4/3) loam, dark grayish brown (10YR 4/2) ped faces; few fine faint yellowish brown (10YR 5/6), grayish brown (2.5Y 5/2), and strong brown (7.5YR 5/8) mottles; moderate fine and medium prismatic structure parting to moderate fine and medium subangular blocky structure; friable; few thin patchy clay films in pores; many thick coatings of clean sand particles on ped faces; about 4 percent coarse fragments with more larger fragments, coarse gravel and cobbles, in upper part; clear wavy boundary.

IIB23t 70L1072 59 to 87 cm (23 to 34 inches) Yellowish brown (10YR 5/8) loam, light brownish gray (10YR 6/2) ped faces, few fine distinct light brownish gray (10YR 6/2) mottles; moderate to strong medium and coarse prismatic structure parting to moderate fine and medium subangular blocky structure; friable to firm; few thin patchy clay films in pores; many thick coatings of clean sand particles on ped faces; about 5 percent coarse fragments; clear wavy boundary.

IIB24t 70L1073 87 to 127 cm (23 to 50 inches) Yellowish brown (10YR 5/6) loam, light brownish gray (10YR 6/2) ped faces; few fine distinct strong brown (7.5YR 5/8) and many fine distinct light brownish gray (10YR 6/2) mottles; strong coarse prismatic structure parting to moderate fine and medium subangular blocky structure; firm; thin patchy clay films in pores; many thick coatings of clean sand particles on ped faces; about 5 percent coarse fragments; few Fe-Mn oxide masses; clear wavy boundary.

IIC1 70L1074 127 to 168 cm (50 to 66 inches) Yellowish brown (10YR 5/6) loam, many fine and medium distinct grayish brown (10YR 5/2) mottles; massive with oblique partings; firm; few lime concretions; few soft lime coatings on parting faces; few thick clay fillings in root channels; few thick coatings of clean sand particles on partings; about 5 percent coarse fragments; calcareous; clear wavy boundary.

IIC2 70L1075 168 to 225 cm (66 to 89 inches) Yellowish brown (10YR 5/4 and 5/6) loam; common coarse prominent strong brown (7.5YR 5/8) mottles; massive with oblique partings; firm; 5 percent coarse fragments; soft lime coatings and clean sand particles on partings; calcareous; clear wavy boundary.

IIC3 70L1076 225 to 265 cm (89 to 106 inches) Yellowish brown (10YR 5/4 and 5/6) loam; common coarse prominent strong brown (7.5YR 5/8) mottles; auger sample but sand coated partings evident; about 5 percent coarse fragments; calcareous; clear wavy boundary.

IIC4 70L1077 265 to 310 cm (106 to 124 inches) Yellowish brown (10YR 5/4 and 5/6) loam or sandy clay loam; auger sample but few sand coated partings evident; about 5 percent coarse fragments; calcareous; clear wavy boundary.

IIC5 70L1078 310 to 360 cm (124 to 144 inches) Yellowish brown (10YR 5/6 and 5/8) loam or sandy clay loam; about 5 percent coarse fragments; auger sample.

Remarks: A pedon each of the Racine series (S70 MN-20-1) and the Kasson series S70 MN-20-2) was sampled in the immediate vicinity. Samples were collected from a pit that was dug with a backhoe.

SOIL CLASSIFICATION-TYPIC BOROSAPRIST
DISIC
SERIES - - - - - - -LOXLEY

SOIL NO - - - - - - S72MN-31-1 COUNTY - - - ITASCA

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 72L576-72L579 72L629-72L635

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, NTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

MARCH 1977

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B	RATIO
		FINE (- - - - - SAND - - - - -) (- - -SILT- - -) FABL INTB FINE NON- 8D1	
		SAND SILT CLAY CLAY VCOS CORS MEDS FNES VFNS COSI FNSI VFSI TEXT II CLAY CO3- 15-	
		2- .05- LT LT 2- 1- .5- .25- .10- .05 .02 .005- SAND .2- TO CLAY BAR	
		.05 .002 .002 .0002 1 .5 .25 .10 .05 .02 .002 .002 2-.1 .02 CLAY TO	
CM		(- PCT LT 2MM -) PCT PCT CLAY	
0-020	OI1		
20-030	OE1		
30-040	OA1		
40-044	OE2		
44-325	OA2		
325-360	OE3		
360-385	LC01		
385-410	LC02		
410-420	OI2		
420-440	LCA		
440-450	2CG		

DEPTH	(PARTICLE SIZE ANALYSIS, HB, 3B, 3B1, 3B2)					(BULK DENSITY)				(- - - -WATER CONTENT- - - -)				CARBONATE		(- -PH - -)	
	VOL. (- - - - - - - - WEIGHT - - - - - - - -)					FIELD	4A1B	4D1	4B1C	4B1C	4B2A	4C1	FIELD	6E1B	3A1A	8C1A	8C1B
	GT 2	GT 75	75-20	20-5	5-2	LT .074	20-2	STATE OVEN	COLE	1/10 BAR	1/3- BAR	15- BAR	WRD CM/	STATE	LT 2	LT .002	1/1 H20	1/2 CACL
CM	PCT	PCT	(- - - PCT LT 75 - - -)			LT20	G/CC	G/CC		PCT	PCT	PCT	CM	PCT	PCT	PCT		
0-020												104		1100				
20-030												102		824				
30-040																		
40-044												95		766				
44-325												89		605				
325-360																		
360-385																		
385-410																		
410-420																		
420-440																		
440-450																		

DEPTH	(ORGANIC MATTER)			IRON	PHOS	(- -EXTRACTABLE BASES 5B4A- -)					ACTY	AL	(CAT EXCH)		RATIO	RATIO	CA	(BASE SAT)	
	6A1A ORGN CARB	6B1A NITG	C/N	6C2B EXT FE	TOTL	6N2E CA	6O2D MG	6P2B NA	6Q2B K	SUM EXTB	6H1A BACL TEA	6G1E KCL EXT	5A3A EXTB ACTY	5A6A BHAC	8D1 NHAC TO	8D3 CA TO	5F1 SAT BHAC	5C3 EXTB ACTY	5C1 NHAC
CM	PCT	PCT		PCT	PCT	(- - - - - - - - - - - -MEQ / 100 G- - - - - - - - - - -)									CLAY	MG	PCT	PCT	PCT
0-020	53.6					9.4	6.4	.4	2.9	19.1	108		127	104		1.5	9	15	18
20-030	53.6					12.1	3.8	.3	.7	16.9	123		140	107		3.2	11	12	16
30-040																			
40-044	58.5					8.1	2.0	.3	.4	10.8	136		147	93.7		4.1	9	7	12
44-325						13.2	1.4	.2	.2	15.0	138		153	89.7		9.4	15	10	17
325-360																			
360-385																			
385-410																			
410-420																			
420-440																			
440-450																			

DEPTH	(SATURATED PASTE)			NA	NA	SALT	GYP	(- - - - - - - - - - SATURATION EXTRACT 8A1- - - - - - - - - -)								ATTERBERG	
	8E1 REST OHM-	8C1B PH	8A H2O	5D2 ESP	5E SAR	8D5 TOTL SOLD	6F1A	8A1A EC MMHOS/	6N1B CA	6O1B MG	6P1B NA	6Q1B K	6I1A CO3	6J1A HCO3	6K1A CL	6L1A SO4	6M1A NO3	4P1 LQID LMIT	4P2 PLST INDX
CM	CM		PCT	PCT		PPM	PCT	CM	(- - - - - - - - - - MEQ / LITER - - - - - - - - - -)									PCT	
0-020	8000	3.3	1433			1300		.14	.1	.1	TR	.6	0	0	0	0			
20-030	7000	3.3	953			920		.15	.3	.2	TR	.2	0	0	0	0			
30-040																			
40-044	11600	3.4	1018			650		.10	.1	TR	0	TR	0	0	0	0			
44-325	11600	4.1	829			640		.12	.1	TR	TR	TR	0	0	0	0			
325-360																			
360-385																			
385-410																			
410-420																			
420-440																			
440-450																			

DEPTH	(- - - - - - - - - - - - - - - - HISTOSOL CHARACTERIZATION- - - - - - - - - - - - - - - -)												
	(STATE OF DECOMPOSITION)			PH	(BULK DEN)	COLE	SUBS	(- -WATER CONTENT- -)					
	8F MINL CONT	8G (FIBER VOL) RUB	8H PYROPHOSPHT SOLUBILITY	8C1E .01M CACL	4A3A FILD STAT G/CC	1/3B 1/3 BENT G/CC	4D1 BE- WET	BES- IDUE PCT	4B4 FILD STAT PCT	4B1C 1/3B BENT PCT	4B2 15- BAR PCT	4C1 WRD CM/ CM	
CM	PCT	PCT	PCT										
0-020	11	94	66	7.5YR 5/4	2.9				1100		96		
20-030	19	82	21	7.5YR 5/4	3.2				824		84		
30-040	7	96	44	7.5YR 6/4	3.1								
40-044	6	82	60	10YR 6/4	3.1				766		86		
44-325				7.5YR 5/4					601		62		
325-360		88	49	10YR 7/4	3.9								
360-385		41	17	7.5YR 5.5/4	4.3								
385-410		16	6	7.5YR 5/4	4.4								
410-420		76	54	10YR 6/4	4.2								
420-440	97	<1		10YR 7.5/4	4.7								
440-450				10YR 8/3	4.8								

Pedon classification: Typic Borosaprist; dysic (see remarks).
Series classification: Same.
Soil: Loxley series.
Soil No.: S72(73).MN-31-1.
Location: Itasca County, Minnesota; Marcell Experimental Forest; bog in watershed S-2; NW ¼, NW ¼, NW ¼, Sec. 13, T. 58 N., R. 25 W. About 47.5 deg. north latitude and about 93.5 deg. west longitude.
Climate: Humid continental. Mean annual temperature is 39 deg. F.; mean summer temperature is 65 deg. F. and mean winter temperature is 10 deg. F. Mean annual precipitation is 25 inches; mean May through September precipitation is 17 inches; total annual snowfall is about 55 inches. Frost-free period is about 100 days.
Parent material: Organic soil materials derived from sphagnum moss and herbaceous plants over limnic materials over glacial lacustrine sediments.
Physiography: Superior Uplands (Central Lowlands?) Marcell Moraine Complex of St. Louis sublobe of the Late Wisconsin glaciation. Area is rolling and maximum local relief is about 30 feet. Bog is inset about 20 feet, and it is in a closed depression. Elevation is about 1,450 feet.
Vegetation: Black spruce forest with about 60 percent crown cover; sparse understory consisting mostly of labrador tea and leather leaf; ground cover mostly of spahgnum mosses. Basal area is 90 sq. ft./acre. Site index of black spruce is 27.
Size of bog: About 10 acres. Bog is oval shaped. Distance to adjacent mineral land: About 200 feet.
Microrelief: Few hummocks as much as 1 foot in height.
Depth to water table: Water table is at soil surface. Water table is a local perched water table rather than the regional water table.
Subsidence: None.
Observers: Pedon described and sampled by R. S. Farnham, H. R. Finney, W. E. McKinzie, and W. C. Lynn. Tree growth measurements by E. R. Amborn, W. F. Johnston, and E. Verry. Both operations were performed on July 24, 1972. Samples were obtained with Macaulay peat sampler and spade.

Oi1 721576 0 to 20 cm Dark brown (10YR 4/3, broken face and rubbed) fibric material, very pale brown (10YR 7/3, pressed); about 80 percent fiber, about 60 percent rubbed; massive; mostly sphagnum moss fiber with about 5 percent woody fiber and fragments; about 10 percent mineral material; gradual boundary.

Oe1 721577 20-30 cm Very dark grayish brown (10 YR 3/2, broken face and rubbed) hemic material; about 50 percent fiber, about 30 percent rubbed; massive; mixed sphagnum moss and herbaceous fiber with about

Oa1 721629 30-40 cm Dark brown (7.5YR 3/2, broken face and rubbed) sapric material; about 30 percent fiber, about [illegible] percent rubbed; massive; mostly herbaceous fiber with about 5 percent woody fiber and

SOIL CLASSIFICATION-TYPIC BOROSAPRIST
EUIC
SERIES - - - - - - - -LUPTON

SOIL NO - - - - - - - S72BM-31-2 COUNTY - - - ITASCA

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 72L580-72L587

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, NTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

MARCH 1977

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B												RATIO			
					FINE	SAND						SILT		FAML	INTR	FINE	NON-	8D1
		SAND	SILT	CLAY	CLAY	VCOS	CORS	MEDS	FNES	VFNS	COSI	FNSI	VFSI	TEXT	II	CLAY	CO3-	15-
		2-	.05-	LT	LT	2-	1-	.5-	.25-	.10-	.05	.02	.005-	SAND	.2-	TO	CLAY	BAR
		.05	.002	.002	.0002	1	.5	.25	.10	.05	.02	.002	.002	2-.1	.02	CLAY		TO
CM		PCT LT 2MM														PCT	PCT	CLAY
000-018	OA1																	
018-055	OE																	
055-132	OA2																	
132-300	OA3																	
300-385	OA4																	
385-420	LCA																	
420-475	LCO																	
475-490	2CG																	

DEPTH	PARTICLE SIZE ANALYSIS, 4B, 3B, 3B1, 3B2					BULK DENSITY			WATER CONTENT				CARBONATE		PH	
	VOL.	WEIGHT											6E1B	3A1A	8C1A	8C1E
	GT	GT	75-20	20-5	5-2	LT	20-2	1/3-	OVEN	COLE	1/10	1/3-	15-	WRD	LT	LT	1/1	1/2
	2	75				.074	PCT	BAR	DRY		BAR	BAR	BAR	CM/	2	.002	H2O	CACL
CM	PCT	PCT	PCT LT 75			LT20	G/CC	G/CC			PCT	PCT	PCT	CM	PCT	PCT		
000-018													79					
018-055													87					
055-132																		
132-300																		
300-385																		
385-420																		
420-475																		
475-490																		

DEPTH	ORGANIC MATTER			IRON	PHOS	EXTRACTABLE BASES 5B4A					ACTY	AL	CAT EXCH		RATIO	RATIO	CA	BASE SAT	
	6A1A	6B1A	C/N	6C2B		6N2E	6Q2D	6P2B	6Q2B		6H1A	6G1E	5A3A	5A6A	8D1	8D3	5F1	5C3	5C1
	ORGN	NITG		EXT	TOTL	CA	MG	NA	K	SUM	BACL	KCL	EXTB	NHAC	NHAC	CA	SAT	EXTB	NHAC
000-018	62.6					145	15.4	.3	1.7	162	44.0		206	140		9.4	104	79	116
018-055	62.0					193	15.7	.3	.2	209	39.6		249	172		12.0	112	84	122
055-132																			
132-300																			
300-385																			
385-420																			
420-475																			
475-490																			

DEPTH	SATURATED PASTE			BA	NA	SALT	GYP	SATURATION EXTRACT 8A1								ATTERBERG		
	8E1	8C1B	8A	5D2	5E	8D5	6F1A	8A1A	6N1B	6Q1B	6P1B	6Q1B	6I1A	6J1A	6K1A	6L1A	6N1A	4F1	4F2
	BEST	PE	H2O	ESP	SAR	TOTL		EC	CA	MG	NA	K	CO3	HCO3	CL	SO4	NO3	LQID	PLST
	ORM-					SOLU		MMHOS/										LMIT	INDX
CM	CM		PCT	PCT		PPM	PCT	CM	(- - - - - - - - - - MEQ / LITER - - - - - - - - - -)									PCT	
000-018	5700	6.6	583			710		.19	1.6	.4	.1	.4	0	.9		0			
018-055	1100	6.0	540			5300		1.49	17.3	3.5	.2	.1	0	0		18.8			
055-132																			

Soil: Lupton Series.
Soil No.: S72(73)MN-31-2.
Location: Itasca County, Minnesota; Marcell Experimental Forest; bog in watershed S-3; SE ¼, NE ¼, NW ¼, Sec. 12, T. 58 N., R. 25 W. About 47.5 deg. north latitude and about 93.5 deg. west longitude.
Climate: Humid continental. Mean annual temperature is 39 deg. F.; mean summer temperature is 65 deg. F. and mean winter temperature is 10 deg. F. Mean annual precipitation is 25 inches; mean May through September precipitation is 17 inches; total annual snowfall is about 55 inches. Frost-free period is about 100 days.
Parent material: Organic soil materials derived primarily from woody plants over limnic materials over sandy glacial sediments.
Physiography: Superior Uplands (Central Lowlands?); Marcell Moraine Complex of the St. Louis sublobe of the Late Wisconsin glaciation. Area is rolling and maximum local relief is about 30 feet. Bog is inset about 20 feet and is in a broad, low-gradient drainageway that flows into a nearby lake. Elevation is about 1,450 feet.
Vegetation: Black spruce forest with about 40 percent crown cover; a few white cedar, paper birch, and balsam fir; a moderate understory consisting mostly of alder, dogwood, and labrador tea; a few clumps of sphagnum moss. Basal area is 80 sq. ft./acre. Site index of black spruce is 41.
Size of bog: About 30 acres in immediate area but this peatland extends through a narrow gap into another elongated area about 100 acres in size.
Distance to adjacent mineral land: About 200 feet.
Microrelief: Slight but a few hummocks as much as 1 foot in height.
Depth to water table: Water table is at soil surface. Water table is regional.
Subsidence: None.
Observers: Pedon described and sampled by R. S. Farnham, H. R. Finney, W. E. McKinsie, and W. C. Lynn. Tree growth measurements by K. B. Ahborn, W. F. Johnston, and E. Varner. Both operations were performed on

Oa1 72L580 0 to 18 cm Black (N2/, broken face and rubbed) sapric material; about 15 percent fiber, trace after rubbing; massive; woody fiber; about 20 percent mineral material; common live roots; gradual boundary.

Oe 72L581 18 to 55 cm Very dark brown (10YR 2/2, broken face and rubbed) hemic material; about 50 percent fiber, about 20 percent rubbed; weak fine granular structure; woody fiber; about 10 percent mineral material; pH 5.5; gradual boundary.

Oa2 72L582 55 to 132 cm Black (10YR 2/1, broken face and rubbed) matrix and dark brown (7.5YR 3/2 & 4/4) fiber, sapric material; about 40 percent fiber, about 15 percent rubbed; weak fine granular structure; woody fiber; about 10 percent woody fragments; about 15 percent mineral material; pH 5.5; gradual boundary.

Oa3 72L583 132 to 300 cm Black (10YR 2/1, broken face and rubbed) matrix and strong brown (7.5YR 5/6) fiber, sapric material; about 25 percent fiber, about 10 percent rubbed; massive; woody fiber; few thin layers with 15 to 25 percent of highly weathered woody fragments; about 30 percent mineral material; gradual boundary.

Oa4 72L584 300 to 385 cm Very dark brown (10YR 2/2, broken face and rubbed) sapric material; about 45 percent fiber, about 10 percent rubbed; massive; mostly herbaceous fiber with a trace of woody fiber; about 20 percent mineral material; abrupt boundary.

Lca 72L585 385 to 420 cm Olive gray (5Y 5/2, broken face and rubbed) marl; trace of plant detritus; massive; about 80 percent mineral material; gradual boundary.

Lco 72L586 420 to 475 cm Dark greenish gray (5GY 4/1, broken face and rubbed) coprogenous earth; trace of plant detritus; massive; slightly sticky; about 90 percent mineral material; abrupt boundary.

SOIL CLASSIFICATION-TERRIC BOROSAPRIST
LOAMY, MIXED, EUIC
SERIES - - - - - - -LUPTON (TAXADJUNCT)

SOIL NO - - - - - - S72MN-36-1 COUNTY - - - KOOCHICHING

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 72L588-72L593

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, MTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

MARCH 1977

DEPTH CM	HORIZON	SAND 2-.05	SILT .05-.002	CLAY LT .002	FINE CLAY LT .0002	VCOS 2-1	CORS 1-.5	MEDS .5-.25	FNES .25-.10	VFNS .10-.05	COSI .05-.02	FNSI .02-.002	VFSI .005-.002	FAML TEXT SAND 2-.1	INTR II .2-.02	FINE CLAY TO CLAY PCT	NON-CO3-CLAY PCT	RATIO 8D1 15-BAR TO CLAY
		(- - PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B - - PCT LT 2MM - -)																
000-008	OA1																	
008-016	OE																	
016-105	OA2																	
105-107	2A1B																	
107-124	2C1G																	
124-140	3C2G																	

DEPTH CM	VOL. GT 2 PCT	WEIGHT GT 75 PCT	75-20	20-5	5-2	LT .074	20-2 PCT LT20	BULK DENSITY 4A1D 1/3-BAR G/CC	4A1H OVEN DRY G/CC	4D1 COLE	WATER CONTENT 4B1C 1/10 BAR PCT	4B1C 1/3-BAR PCT	4B2A 15-BAR PCT	4C1 WRD CM/CM	CARBONATE 6E1B LT 2 PCT	3A1A LT .002 PCT	PH 8C1A 1/1 H2O	8C1E 1/2 CACL
			(- - - PCT LT 75 - - -)															
000-008													80					
008-016													85					
016-105													82					
105-107																		
107-124																		
124-140																		

DEPTH CM	ORGANIC MATTER 6A1A ORGN CARB PCT	6B1A NITG PCT	C/N	IRON 6C2B EXT FE PCT	PHOS TOTL PCT	EXTRACTABLE BASES 5B4A 6N2E CA	6O2D MG	6P2B NA	6Q2B K	SUM EXTB	ACTY 6H1A BACL TEA	AL 6G1E KCL EXT	CAT EXCH 5A3A EXTB ACTY	5A6A NHAC	RATIO 8D1 NHAC TO CLAY	RATIO 8D3 CA TO MG	CA 5F1 SAT NHAC PCT	BASE SAT 5C3 EXTB ACTY PCT	5C1 NHAC PCT
						(- - - MEQ / 100 G - - -)													
000-008	52.7					46.7	14.7	.3	3.2	64.9	121		186	120		3.2	39	35	54
008-016	55.5					64.3	22.9	.2	.3	87.7	103		191	135		2.8	48	46	65
016-105	58.0					117.0	37.4	.3	.2	155.0	117		272	194		3.1	60	57	80
105-107																			
107-124																			
124-140																			

DEPTH CM	SATURATED PASTE 8E1 REST OHM-CM	8C1B PH	8A H2O PCT	NA 5D2 ESP PCT	NA 5E SAR	SALT 8D5 TOTL SOLU PPM	GYP 6F1A PCT	SATURATION EXTRACT 8A1 8A1A EC MMHOS/CM	6N1B CA	6O1B MG	6P1B NA	6Q1B K	6I1A CO3	6J1A HCO3	6K1A CL	6L1A SO4	6M1A NO3	ATTERBERG 4F1 LQID LMIT PCT	4F2 PLST INDX
									(- - - MEQ / LITER - - -)										
000-008	720	4.0	779			13000		2.41	5.8	4.8	.1	2.1	0	.9	0	.9			
008-016	5700	4.7	588			680		.18	1.2	.9	TR	TR	0	.4	0	0			
016-105	5300	4.8	548			700		.20	1.2	1.0	TR	TR	0	0	0	.5			
105-107																			
107-124																			
124-140																			

DEPTH CM	HISTOSOL CHARACTERIZATION (STATE OF DECOMPOSITION) 8F MINL CONT PCT	8G (FIBER VOL) UNRB PCT	8G RUB PCT	8H PYROPHOSPHT SOLUBILITY	PH 8C1E .01M CACL	BULK DEN 4A3A FILD STAT G/CC	4A1I 1/3B REWT G/CC	COLE 4D1 RE-WET	SUBS RES-IDUE PCT	WATER CONTENT 4B4 FILD STAT PCT	4B1C 1/3B REWT PCT	4B2 15-BAR PCT	4C1 WRD CM/CM
000-008	29	44	10	7.5YR 3/2	4.3					560		72	
008-016	17	37	10	7.5YR 3/2	4.6					438		72	
016-105	17	41	8	7.5YR 3/2	5.1	.17			78	505		64	
105-107				7.5YR 3/2	5.4								
107-124													
124-140					7.2								

Pedon classification: Terric Borosaprist; loamy, mixed, euic.
Series classification: Typic Borosaprists; euic.
Soil: Lupton series (taxadjunct).
Soil No.: S72MN-36-1.
Location: Koochiching County, Minnesota; Big Falls Experimental Forest; NE ¼, NE ¼, Sec. 36, T. 157 N., R. 25 W. About 48.5 deg. north latitude and about 94.2 west longitude.
Climate: Humid continental. Mean annual temperature is 37 deg. F.; mean summer temperature is 64 deg. F.; mean winter temperature is 8 deg. F. Mean annual precipitation is 24 inches; mean May through September precipitation is 16 inches; total annual snowfall is about 55 inches. Frost-free period is about 100 days.
Parent materials: Organic soil material derived mostly from woody plants over clayey glacial lacustrine sediments.
Physiography: Central Lowlands; Agassiz Lacustrine Plain (Big Fork Valley). Area is nearly level and local relief is mostly less than 5 feet. Elevation is about 1,200 feet.
Vegetation: Black spruce forest with about 50 percent crown cover; rather lush understory consisting mostly of labrador tea, dogwood, alder, raspberry, lingonberry and balsam fir; ground cover is mostly hypnum moss. Basal area is about 110 sq. ft./acre. Site index of black spruce is about 43.
Size of bog: Several thousands acres - the Lake Agassiz peatlands.
Distance to adjacent mineral land: About 1,200 feet to a low rise of mineral land that is about 50 acres in size. The mineral land is completely surrounded by peatland.
Microrelief: Common hummocks as much as 1 foot in height.
Depth to water table: At soil surface. Subsidence: None.
Observers: Described and sampled by R. S. Farnham, W. E. McKinzie, H. R. Finney, and W. C. Lynn. Tree growth measurements by E. R. Amborn and W. F. Johnston. Both operations were performed on July 25, 1972. Most samples were obtained with the Macaulay peat sampler. Samples of upper layers were obtained from small pit that was opened with a spade.

Oa1 72L588 0 to 8 cm Very dark brown (10YR 2/1, rubbed); about 25 percent fiber, about 5 percent rubbed; weak fine and medium crumb structure; very friable; mostly woody fiber, few woody fragments; about 20 percent mineral material; gradual boundary.

Oe 72L589 8 to 16 cm. Dark brown (7.5YR 3/2, broken face) hemic material, very dark brown (10YR 2/2, rubbed); about 60 percent fiber, about 20 percent rubbed; massive; mixed sphagnum and hypnum moss fiber; about 15 percent mineral material; abrupt boundary.

Oa2 72L590 16 to 105 cm Black (10YR 2/1, broken face) and very dark brown (10YR 2/2, broken face) matrix with mostly dark brown (7.5YR 4/4, broken face) fiber, sapric material, black (10YR 2/1, rubbed); about 25 percent fiber, about 10 percent rubbed; weak fine and medium crumb structure; very friable; woody fiber, few woody fragments; about 25 percent mineral material; abrupt boundary.

IIA1b 72L591 105 to 107 cm Very dark gray (10YR 3/1) silty clay loam; massive; sticky; abrupt boundary.

IIC1g 72L592 107 to 124 cm Gray (5Y 5/1) sandy clay loam; massive; slightly sticky; clear boundary.

IIIC2g 72L593 124 to 140 cm Greenish gray (5GY 5/1) clay; massive; sticky.

Remarks: The depth to the mineral substratum ranges from 70 to 110 cm within a short distance from this pedon. A living mat mostly of Sphagnum Magellanicum and about 8 cm in thickness is at this site. Samples for measurement of bulk density were obtained at depths of 25-30, 30-35, and 48-53 cm. Samples for measurement of content of fiber were collected at depths of 2-8, 12-16, 30-34, 60-64, and 80-84 cm. Two other pedons were sampled in this area on this day. The others had black spruce with lower site-index than this site. **This pedon is a taxadjunct to the Lupton series because the fiber in the sapric material is mostly woody.**

SOIL CLASSIFICATION-CUMULIC HAPLAQUOLL
FINE, MONTMORILLONITIC, MESIC
SERIES - - - - - - -LURA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, MTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

SOIL NO - - - - - - S69MN-7-7 COUNTY - - - BLUE EARTH

GENERAL METHODS- - -1A, 1B1B, 2A1, 2B SAMPLE NOS. 69B806-69B810 (A) JULY 1976

69L934-69L935

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B															RATIO
					FINE	SAND						SILT			FAML	INTR	FINE	NON-	8D1
		SAND	SILT	CLAY	CLAY	VCOS	CORS	MEDS	FNES	VFNS	COSI	FNSI	VFSI	TEXT	II	CLAY	CO3-	15-
		2-	.05-	LT	LT	2-	1-	.5-	.25-	.10-	.05	.02	.005-	SAND	.2-	TO	CLAY	BAR
		.05	.002	.002	.0002	1	.5	.25	.10	.05	.02	.002	.002	2-.1	.02	CLAY		TO
CM		PCT LT 2MM															PCT	CLAY
000-33	AP	6.5	43.5	50.0	19.4	0.2	0.3	0.8	2.6	2.7	11.9	31.6	12.5	3.8	16.3	39		0.51
033-51	A12	5.7	45.9	48.4	15.6	0.2	0.4	0.4	1.5	3.2	13.5	32.4		2.5	17.7	32		0.50
051-66	A13																	
066-117	A14	5.9	44.1	50.0	28.2	0.1	0.4	0.6	2.0	2.8	11.3	32.8		3.1	17.2	56		0.46
147-183	CG	7.8	41.5	50.7	24.5	0.2	0.4	1.3	3.1	2.8	10.0	31.5		5.0	14.6	48		0.45

DEPTH	PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2						BULK DENSITY				WATER CONTENT				CARBONATE		PH	
	VOL.	WEIGHT					4A1D	4A1H	4D1	4B1C	4B1C	4B2	4C1		6E1B	3A1A	8C1A	8C1E
	GT	GT					1/3-	OVEN	COLE	1/10	1/3-	15-	WRD		LT	LT	1/1	1/2
	2	75					.074	PCT		BAR	BAR	BAR	CM/		2	.002	H2O	CACL
CM	PCT	PCT	75-20	20-5	5-2	LT	LT20	G/CC	G/CC		PCT	PCT	PCT	CM	PCT	PCT		
000-33	TR	0	0	0	TR	95		1.38	1.61	.053	43.1	41.2	25.6	.22	3.5C	1	7.1	
033-51	TR	0	0	0	TR	97		1.30B					24.2			1	7.0	
051-66	TR	0	0	0	TR			1.20	1.71	.125	41.8	37.9	22.6	.18		1	7.0	
066-117	TR	0	0	0	TR	96		1.30B					23.0			1	6.8	
147-183	TR	0	0	0	TR	94							22.9			1	7.1	

DEPTH	ORGANIC MATTER			IRON	PHOS	EXTRACTABLE BASES 5B4A				ACTY	AL	(CAT EXCH)		RATIO	RATIO	CA	(BASE SAT)	
	6A1A	6B1A	C/N	6C2B	6S1A	6N2E	6D2D	6P2B	6Q2B		6H2A	6G1D	5A3A	5A6A	8D1	8D3	5F	5C3	5C1
	ORGN	NITG		EXT	TOTL	CA	MG	NA	K	SUM	BACL	KCL	EXTB	NHAC	NHAC	CA	SAT	EXTB	NHAC
	CARB			FE						EXTB	TEA	EXT	ACTY		TO	TO	NHAC	ACTY	
CM	PCT	PCT		PCT	PCT	MEQ / 100 G									CLAY	MG	PCT	PCT	PCT
000-33	6.62D	0.521	13																
033-51	1.64	0.122	13																
051-66	1.39	0.098	14																
066-117	1.19	0.101	12																
147-183	0.46																		

DEPTH	SATURATED PASTE		NA	NA	SALT	GYP	SATURATION EXTRACT 8A1									ATTERBERG	
	8E1	8C1B	8A	5D2	5E	8D5	6F1A	8A1A	6N1B	6D1B	6P1A	6Q1A	6I1A	6J1A	6K1A	6L1A	6M1A	4F1	4F2
	REST	PH	H2O	ESP	SAR	TOTL		EC	CA	MG	NA	K	CO3	HCO3	CL	SO4	NO3	LQID	PLST
	OHM-					SOLU		MMHOS/										LMIT	INDX
CM	CM		PCT	PCT		PPM	PCT	CM	MEQ / LITER									PCT	
000-33																			
033-51																			
051-66																			
066-117	2000	7.0																	
147-183	2000	7.0																	

ANALYSES BY MINNESOTA AGRICULTURAL EXPERIMENT STATION, ST PAUL, MN. MINERALOGY BY X-RAY ANALYSIS. TOTAL PHOSPHORUS BY NITRIC-PERCHLORIC DIGESTION. AVAILABLE PHOSPHORUS BY BRAY'S NO 1 EXTRACTANT.

DEPTH	MINERALOGY					TOTAL P	AVAIL P
	MONT	VERM	ILLITE	KAOL	QUARTZ		
	PCT LT .002MM					LBS/A	
000-33						1396	31
033-51							3
051-66						564	2
066-117							3
147-183						1028	16

(A) BULK DENSITY AND WATER CONTENT ANALYSES BY THE SOIL SURVEY INVESTIGATIONS UNIT, LINCOLN, NE. UNLESS OTHERWISE INDICATED REMAINING ANALYSES BY THE SOIL SURVEY INVESTIGATIONS UNIT, BELTSVILLE, MD.

(B) ESTIMATED.

(C) MICRO-PENETRATION RESISTANCE - A ROD 0.6 CM DIA IS SLOWLY PUSHED INTO BULK DENSITY CLOD, EQUILIBRATED AT 1/10-BAR, A DISTANCE OF 0.6 CM USING A POCKET PENETROMETER. UNITS ARE FORCE (KG) AND NOT ESTIMATES OF UNCONFINED COMPRESSIVE STRENGTH.

(D) ORGANIC CARBON IS 41 KG/M SQ TO A DEPTH OF 1 M (6A).

Pedon classification: Cumulic Haplaquoll; fine, montmorillonitic, mesic.
Series classification: Same.
Soil: Lura series.
Soil No.: S69MN-7-7.
Location: Blue Earth County, Minnesota; NE1/4 of SW1/4, sec. 26, T. 105 N., R. 27 W. (Sterling Twp.); about 800 feet south and 360 feet west of northeast corner of SW1/4, sec. 26. About 94 deg. 2 min. west longitude and 43 deg. 52 min. north latitude.
Climate: Humid continental. Some characteristics of temperature in deg. F. are: annual normal - 46, winter normal - 17, summer normal - 71; some characteristics of precipitation in inches are: annual normal - 28, May through September - 18, normal annual snowfall - 40.
Parent material: Deep, fine textured lacustrine sediments deposited over calcareous loamy glacial till (New Ulm) of the Des Moines Lobe, Late Wisconsin age.
Physiography: Central Lowlands; glacial Lake Minnesota Plain in the Blue Earth Till Plain of H. E. Wright (1972).
Landscape setting: About a 1/2 percent concave slope in a depression. General topography is nearly level to very gently undulating. Relative relief is about 5 feet. Elevation of site is about 1,035 feet. Major associated soils on the landscape near this site are of the Beauford, Waldorf, and Collinwood series.
Vegetation: Recently plowed; native vegetation was a wet-site community of the tall grass prairie.
Drainage: Very poorly drained.
Erosion: None.
Permeability: Slow.
Described by: R. J. Edwards and H. R. Finney on October 22, 1969.
Sampled by: L. Shields, R. H. Rust, R. J. Edwards, and H. R. Finney on October 22, 1969.

Ap 69B806 0 to 33 cm (0 to 13 inches). Black (N 2/) silty clay; weak to moderate very fine subangular blocky structure; friable, plastic and sticky; common roots; abrupt smooth boundary.

A12 69B807 33 to 51 cm (13 to 20 inches) Black (10YR 2/1) silty clay; moderate very fine angular blocky structure; friable to firm, plastic and sticky; clear smooth boundary.

A13 69B808 51 to 66 cm (20 to 26 inches) Black (10YR 2/1) clay; about 30 percent coarse inclusions of very dark gray (5Y 3/1); few fine distinct olive (5Y 5/4) mottles; weak coarse prismatic structure parting to moderate very fine angular blocky structure; firm, plastic and sticky; clear smooth boundary.

A14 69B809 66 to 117 cm (26 to 46 inches) Black (5Y 2/1) clay; moderate very fine angular blocky structure; firm, plastic and sticky; clear smooth boundary.

A15 (not sampled) 117 to 147 cm (46 to 58 inches) Very dark gray (5Y 3/1) silty clay; weak to moderate very fine angular blocky structure; firm, plastic and sticky; clear smooth boundary.

Cg 69B810 147 to 183 cm (58 to 72 inches). Gray (5Y 5/1) and olive gray (5Y 5/2) silty clay; common fine distinct olive (5Y 5/4) mottles; massive; firm to friable, plastic and sticky.

Remarks: Colors are for moist soil. These samples were obtained from a pit with approximate dimensions of 1 x 3 x 2 m in depth. This pedon is representative of the middle segment of the series.

SOIL CLASSIFICATION-TYPIC HAPLAQUOLL
FINE-SILTY, MIXED, MESIC
SERIES - - - - - - -MADELIA

SOIL NO - - - - - - S69MN-7-10 COUNTY - - - BLUE EARTH

GENERAL METHODS- - -1A, 1B1B, 2A1, 2B SAMPLE NOS. 69B825-69B832 (A) JULY 1976

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, MTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

69L936-69L940

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B															RATIO
					FINE	SAND					SILT			FAML	INTR	FINE	NON-	8D1
		SAND	SILT	CLAY	CLAY	VCOS	CORS	MEDS	FNES	VFNS	COSI	FNSI	VFSI	TEXT	II	CLAY	CO3-	15-
		2-	.05-	LT	LT	2-	1-	.5-	.25-	.10-	.05	.02	.005-	SAND	.2-	TO	CLAY	BAR
CM		.05	.002	.002	.0002	1	.5	.25	.10	.05	.02	.002	.002	2-.1	.02	CLAY		TO
		PCT LT 2MM														PCT	PCT	CLAY
000-23	AP	5.7	66.2	28.1	17.2	0.1	0.1	0.1	0.5	4.9	23.4	42.8	12.3	0.8	28.7	61		0.60
023-33	A12	4.9	61.7	33.4	22.0	0.0	0.0	0.1	0.3	4.5	22.2	39.5		0.4	26.9	66		0.51
033-48	A3	5.5	63.1	31.4	21.3	0.1	0.2	0.2	0.5	4.6	23.3	39.8	8.1	0.9	28.3	68		0.49
048-60	B1G	7.3	61.3	31.4	21.1	0.1	0.2	0.2	0.5	6.4	23.1	38.2	7.9	0.9	29.9	67		0.47
060-84	B2G	8.4	57.7	33.9	21.7	0.3	0.5	0.2	0.4	7.0	23.0	34.7		1.4	30.3	64		0.46
084-104	B31G	9.7	64.0	26.3	15.0	0.3	0.6	0.3	0.7	7.8	26.1	37.9		1.9	34.4	57		0.50
104-127	B32G	2.0	71.9	26.1	12.2	0.1	0.3	0.3	0.5	0.9	17.9	54.0	9.3	1.1	19.1	47		0.58
127-160	CG	1.9	79.4	18.7	7.8	0.0	0.4	0.5	0.6	0.4	13.6	65.8		1.5	14.4	42		0.68

DEPTH	PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2					BULK DENSITY			WATER CONTENT				CARBONATE		PH	
	VOL.	WEIGHT											6E1B	3A1A	8C1A	8C1E
	GT	GT	75-20	20-5	5-2	LT	20-2	1/3-	OVEN	COLE	1/10	1/3-	15-	WRD	LT	LT	1/1	1/2
	2	75				.074	PCT	BAR	DRY		BAR	BAR	BAR	CM/	2	.002	H2O	CACL
CM	PCT	PCT	PCT LT 75				LT20	G/CC	G/CC		PCT	PCT	PCT	CM	PCT	PCT		
000-23	TR	0	0	0	TR	99		1.26	1.52	0.065	35.1	35.1	16.8	0.23	2.0C		6.1	
023-33	TR	0	0	0	TR	99		1.30B					17.1				6.0	
033-48	TR	0	0	0	TR	98		1.30	1.50	0.049	29.9	27.7	15.3	0.16			6.3	
048-60	TR	0	0	0	TR	98		1.30B					14.8				6.4	
060-84	TR	0	0	0	TR	98		1.33	1.60	0.064	27.7	26.4	15.6	0.14			6.7	
084-104	TR	0	0	0	TR	97		1.22	1.44	0.057	36.4	34.4	13.2	0.26		1	7.0	
104-127	0	0	0	0	0	99		1.30B					15.2			1	7.3	
127-160	TR	0	0	0	TR	98		1.25	1.33	0.021	40.4	37.8	12.8	0.31		9	7.7	

DEPTH	ORGANIC MATTER			IRON	PHOS	EXTRACTABLE BASES 5B4A-					ACTY	AL	(CAT EXCH)		RATIO		CA	(BASE SAT)	
	6A1A	6B1A	C/N	6C2B	6S1A	6N2E	6O2D	6P2B	6Q2B		6H2A	6G1D	5A3A	5A6A	8D1	8D3	5F	5C3	5C1
	ORGN	NITG		EXT	TOTL	CA	MG	NA	K	SUM	BACL	KCL	EXTB	NHAC	NHAC	CA	SAT	EXTB	NHAC
	CARB			FE						EXTB	TEA	EXT	ACTY		TO	TO	NHAC	ACTY	
CM	PCT	PCT		PCT	PCT	MEQ / 100 G									CLAY	MG	PCT	PCT	PCT
000-23	3.72D	0.253	15																
023-33	3.72	0.250	15																
033-48	1.30	0.096	14																
048-60	0.51	0.057	9																
060-84	0.26																		
084-104	0.25																		
104-127	0.26																		
127-160	0.52																		

DEPTH	(SATURATED PASTE)			NA	NA	SALT	GYP	(SATURATION EXTRACT 8A1-									ATTERBERG	
	8E1	8C1B	8A	5D2	5E	8D5	6F1A	8A1A	6N1B	6O1B	6P1A	6Q1A	6I1A	6J1A	6K1A	6L1A	6M1A	4F1	4F2
	REST	PH	H2O	ESP	SAR	TOTL		EC	CA	MG	NA	K	CO3	HCO3	CL	SO4	NO3	LQID	PLST
	OHM-					SOLU		MMHOS/										LMIT	INDX
CM	CM		PCT	PCT		PPM	PCT	CM	MEQ / LITER									PCT	
000-23																			
023-33																			
033-48																			
048-60																			
060-84																			
084-104	2000	7.2																	
104-127	2000	7.3																	
127-160	3000	7.6																	

ANALYSES BY MINNESOTA AGRICULTURAL EXPERIMENT STATION, ST PAUL, MN. MINERALOGY BY X-RAY ANALYSIS. TOTAL PHOSPHORUS BY NITRIC-PERCHLORIC DIGESTION. AVAILABLE PHOSPHORUS BY BRAY'S NO 1 EXTRACTANT.

DEPTH	MINERALOGY					TOTAL	AVAIL
	MONT	VERM	ILLITE	KAOL	QUARTZ	P	P
	PCT LT .002MM					LBS/A	
000-23						1328	17
023-33							22
033-48						656	7
048-60							4
060-84						910	4
084-104							5
104-127							12
127-160						1456	11

(A) BULK DENSITY AND WATER CONTENT ANALYSES BY THE SOIL SURVEY INVESTIGATIONS UNIT, LINCOLN, NE. UNLESS OTHERWISE INDICATED REMAINING ANALYSES BY THE SOIL SURVEY INVESTIGATIONS UNIT, BELTSVILLE, MD.

(B) ESTIMATED.

(C) MICRO-PENETRATION RESISTANCE - A ROD 0.6 CM DIA IS SLOWLY PUSHED INTO BULK DENSITY CLOD, EQUILIBRATED AT 1/10-BAR, A DISTANCE OF 0.6 CM USING A POCKET PENETROMETER. UNITS ARE FORCE (KG) AND NOT ESTIMATES OF UNCONFINED COMPRESSIVE STRENGTH.

(D) ORGANIC CARBON IS 20 KG/M SQ TO A DEPTH OF 1 M (6A).

Pedon classification: Typic Haplaquoll; fine silty, mixed, mesic.
Series classification: Same.
Soil: Madelia series
Soil No.: 69MN-7-10.
Location: Blue Earth County, Minnesota; SW1/4 of NW1/4, Sec. 30, T. 107 N., R. 27 W. (Rapidan Twp.); about 700 feet north and 500 feet east of southwest corner of NW1/4 of Sec. 30. About 94 deg. 8 min. west longitude and 44 deg. 3 min. north latitude.
Climate: Humid continental. Some characteristics of temperature in deg. F. are: annual normal - 46, winter normal - 17, summer normal - 71; some characteristics of precipitation in inches are: annual normal - 28, May through September - 18, normal annual snowfall - 40.
Parent material: Deep, silty lacustrine sediments of the Des Moines Lobe, Late Wisconsin age.
Physiography: Central Lowlands; glacial Lake Minnesota Plain in the Blue Earth Till Plain of H. E. Wright (1972).
Landscape setting: Less than 1/2 percent, slightly concave slope. General topography is nearly level to undulating. Relative relief in the immediate vicinity is about 10 feet, but the nearby Watonwan River is incised about 150 feet into the plain. Elevation at the site is about 1,000 feet. Major associated soils on the landscape are moderately well-drained Kingston on nearly level to slightly elevated slopes and well-drained Truman soils on stronger slopes.
Vegetation: Recently plowed oat field; native vegetation was tall grass prairie.
Drainage: Poorly drained.
Erosion: Slight.
Permeability: Moderate.
Described by: R. J. Edwards and H. R. Finney on October 23, 1969.
Sampled by: L. Shields, R. J. Edwards, E. R. Gross, J. J. Murray, J. F. Cummins, and H. R. Finney on October 23, 1969.

Ap 69B825 0 to 23 cm (0 to 9 inches) Black (N 2/ to 10YR 2/1) silty clay loam; weak very fine subangular blocky structure; friable, plastic and sticky; common roots; abrupt smooth boundary.

A12 69B826 23 to 33 cm (9 to 14 inches) Black (10YR 2/1) silty clay loam; moderate fine subangular blocky structure; friable, plastic and sticky; common roots; clear smooth boundary.

A3 69B827 33 to 48 cm (14 to 19 inches) Black (10YR 2/1) silty clay loam; moderate very fine subangular blocky structure; friable, plastic and sticky; few roots; about 2 percent olive gray (5Y 4/2) fillings; clear smooth boundary.

B1g 69B828 48 to 60 cm (19 to 23 inches) Dark olive gray (5Y 3/2) and olive gray (5Y 4/2) silty clay loam, very dark gray (10YR 3/1) ped coatings; common fine distinct olive (5Y 4/3) mottles; weak medium prismatic structure parting to moderate very fine subangular blocky structure; friable, plastic and sticky; clear smooth boundary.

B2g 69B829 60 to 84 cm (23 to 33 inches) Dark gray (5Y 4/1) light silty clay loam; grades to gray (5Y 5/1) and olive gray (5Y 5/2) in lower part; common fine distinct olive brown (2.5Y 4/4) and few fine prominent yellowish red (5YR 4/6) mottles; weak medium prismatic structure parting to moderate very fine subangular blocky structure; friable, plastic and sticky; clear smooth boundary.

B31g 69B830 84 to 104 cm (33 to 41 inches) Gray (5Y 5/1) heavy silt loam; common fine prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure parting to weak very fine subangular blocky structure; friable, plastic and sticky; few soft black concretions; clear smooth boundary.

B32g 69B831 104 to 127 cm (41 to 50 inches) Gray (5Y 5/1) and light olive gray (5Y 6/2) silt loam; common fine prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure parting to weak very fine subangular blocky structure; very friable, slightly plastic and slightly sticky; few dark gray krotovina; clear smooth boundary.

Cg 69B832 127 to 160 cm (50 to 60 inches) Light olive gray (5Y 6/2) silt loam; many fine and medium prominent strong brown (7.5YR 5/6) mottles; weak very fine and fine subangular blocky struc-

SOIL CLASSIFICATION-TERRIC BOROSAPRIST
SANDY OR SANDY-SKELETAL, MIXED, EUIC
SERIES - - - - - - - -HARGAT

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, NTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

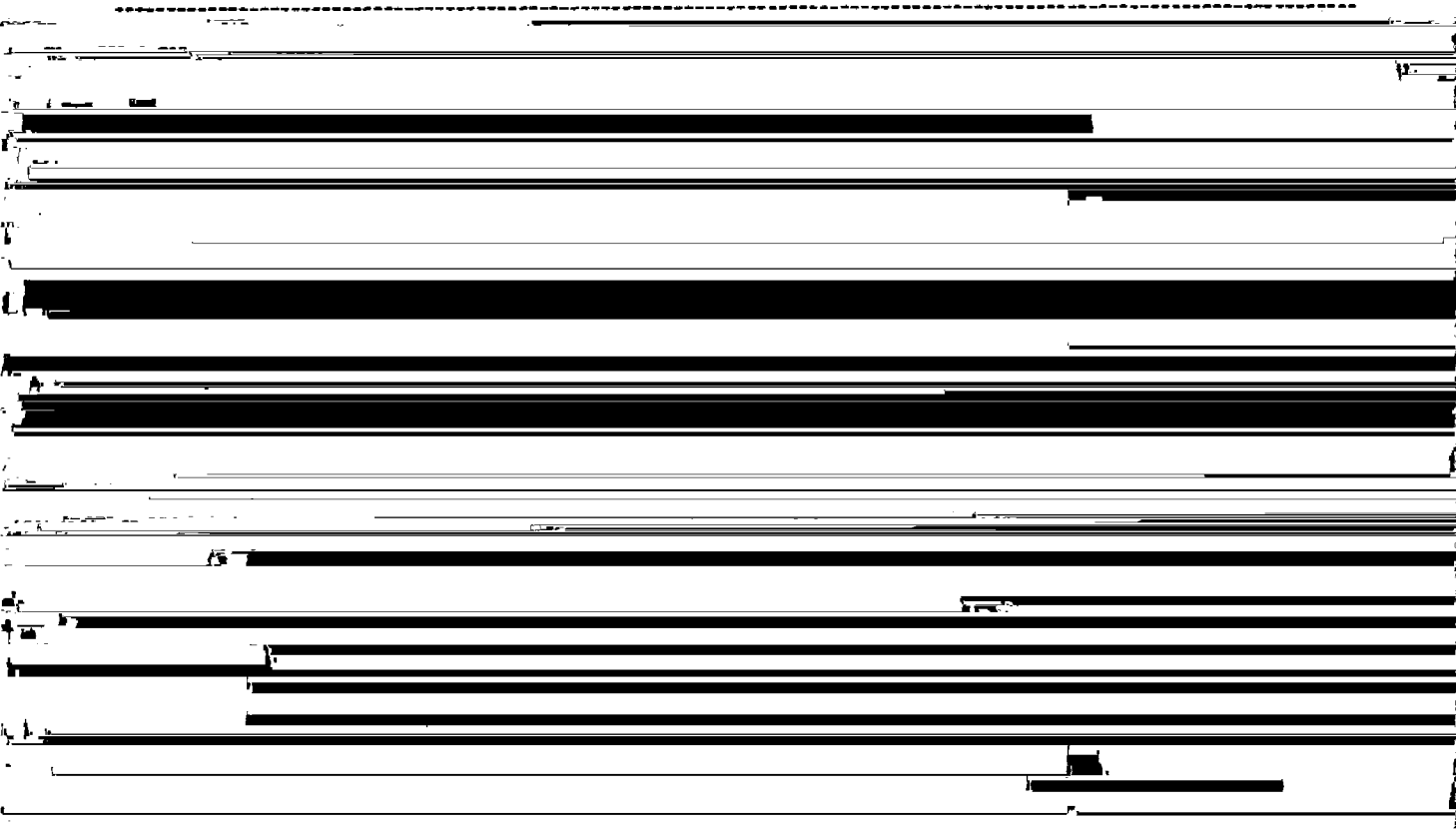
SOIL NO - - - - - - S72NE-35-2 COUNTY - - - KITTSON

GENERAL METHODS- - -1A,1B1E,2A1,2B SAMPLE NOS. 72L610-72L614 MARCH 1977

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B													RATIO
		SAND	SILT	CLAY	FINE CLAY	VCOS SAND	CORS SAND	MEDS SAND	FNES SAND	VFNS SAND	COSI SILT	FNSI SILT	VFSI SILT	FANL TEXT	INTR II	FINE CLAY	NON-CO3-CLAY	8D1 15-BAR TO
		2-.05	.05-.002	LT .002	LT .0002	2-1	1-.5	.5-.25	.25-.10	.10-.05	.05-.02	.02-.002	.005-.002	SAND 2-.1	.2-.02	TO CLAY		CLAY
CM		PCT LT 2MM														PCT	PCT	
0-8	0A1																	
8-31	0E																	
31-108	0A2																	
108-125	0A3																	
125-130	2A1B	54.3	21.0	24.7		3.0	5.5	6.8	32.4	6.6	5.6	15.4		47.7				

DEPTH	PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2 VOL.		WEIGHT			BULK DENSITY			WATER CONTENT				CARBONATE		PH	
	GT 2	GT 75	75-20	20-5	5-2	LT .074	20-2 .074	4A1D 1/3-BAR OVEN DRY	4A1H COLE	4B1C 1/10 BAR	4B1C 1/3-BAR	4B2A 15-BAR	4C1 WRD CM/CM	6E1B LT 2	3A1A .002 H2O	8C1A 1/1	8C1E 1/2 CACL
CM	PCT	PCT	PCT LT 75			LT20	G/CC	G/CC		PCT	PCT	PCT		PCT	PCT		
0-8												86					
8-31												86					
31-108							.23	.53	.316	351	336	90	.59				
108-125												82					
125-130												45					

DEPTH	ORGANIC MATTER 6A1A ORGN CARB	6E1A NITG	C/N	IRON 6C2B EXT FE	PHOS TOTL	EXTRACTABLE BASES 5B4A- 6H2E CA	6O2D MG	6P2E NA	6Q2E K	SUM	ACTY 6H1A BACL TEA	AL 6G1E KCL EXT	(CAT EXCH) 5A3A EXTB ACTY	5A6A NHAC	RATIO 8D1 NHAC TO CLAY	RATIO 8D3 CA TO MG	CA SAT NHAC PCT	(BASE SAT) 5C3 EXTB ACTY PCT	5C1 NHAC PCT
	PCT	PCT		PCT	PCT	MEQ / 100 G													
0-8	47.8					105	44.0	.9	1.0	151	42.8		194	125		2.4	84	78	121
8-31	56.0					111	37.3	1.0	.3	150	43.1		193	129		3.0	86	78	116
31-108	51.2					106	37.8	.7	.4	145	54.3		199	148		2.8	72	73	98
108-125	49.8					132	35.5	.8	.5	169	56.6		226	153		3.7	86	75	110
125-130														110					



Pedon classification: **Terric Borosaprist; sandy or sandy-skeletal, mixed,** euic.
Series classification: **Same.**
Soil: Markey series.
Soil No.: S72MN-35-2.
Location: Kittson County, Minnesota; SW ¼, SW ¼, Sec. 10, T. 159 N., R. 45 W. About 48.8 deg. north latitude and about 97.5 deg. west longitude.
Climate: Humid continental. Mean annual temperature is 38 deg. F.; mean summer temperature is 66 deg. F., and mean winter temperature is 6 deg. F. Mean annual precipitation is 20 inches; mean May through September precipitation is 14 inches; total annual snowfall is about 35 inches. Frost-free period is about 110 days.
Parent material: Organic soil material derived primarily from herbaceous plants over sandy lacustrine sediments of Glacial Lake Agassiz.
Physiography: Central lowlands; Lake Agassiz Plain; area is nearly level and local relief is mostly less than 5 feet. Elevation is about 1,060 feet.
Vegetation: Mostly sedges and grasses with scattered willow and bog birch.
Size of bog: Several hundred acres.
Distance to adjacent mineral land: Over 1,000 feet. Microrelief: Very slight.
Depth to water table: About 88 cm. Subsidence: Slight.
Described and sampled by: D. D. Barron, J. O. Nordin, R. S. Farnham, W. E. McKinzie, W. C. Lynn, and H. R. Finney on July 27, 1972. Samples were obtained from a pit that was dug with a spade.

Oa1 72L610 0 to 8 cm Black (10YR 2/1, broken face) sapric material, black (N 2/, rubbed); about 15 percent fiber, about 5 percent rubbed; weak fine crumb structure; very friable; herbaceous fiber; common live roots; about 20 percent mineral material; clear smooth boundary.

Oe 72L611 8 to 31 cm Very dark brown (10YR 2/2, broken face and rubbed) matrix with dark brown (7.5 YR 3/2, broken face) fiber, hemic material; about 60 percent fiber, about 25 percent rubbed; massive; nonsticky; herbaceous fiber; about 15 percent mineral material; pH 5.5 in water; gradual smooth boundary.

Oa2 72L612 31 to 108 cm Black (10YR 2/1, broken face and rubbed) sapric material; about 30 percent fiber, about 5 percent rubbed; weak medium to very thick platy structure; nonsticky; herbaceous fiber; about 20 percent mineral material; pH 5.5 in water; gradual smooth boundary.

Oa3 72L613 108 to 125 cm Black (N 2/, broken face and rubbed) sapric material; about 15 percent fiber, about 5 percent rubbed; weak coarse angular blocky structure; slightly sticky; herbaceous fiber; about 40 percent mineral material in parts to as much as 60 percent in other parts; abrupt smooth boundary.

IIA1b 72L614 125 to 130 cm Black (N 2/) sandy loam; massive; slightly sticky; clear smooth boundary.

IIC (not sampled) 130 to 140 cm Very dark gray (5Y 3/1) loamy coarse sand; massive.

Remarks: Bulk samples were collected at depths of 0-8, 8-31, 31-108, 108-125, and 125-130 cm. Samples for determination of bulk density were collected at depths of 0-8, 8-31, 45-50, 55-60, 60-70, and 85-90 cm. Samples primarily for determination of content of fiber were collected at depths of 0-8, 15-18, 65-70, 85-90, and 125-130 cm.

SOIL CLASSIFICATION-TYPIC BOROSAPRIST
SANDY OR SANDY SKELETAL, MIXED, EUIC

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, MISC

GENERAL METHODS- - -1A,1B1E,2A1,2B SAMPLE NOS. 72L615-72L619 MARCH 1977

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B													RATIO	
		SAND	SILT	CLAY	FINE SAND	VCOS	COBS	MEDS	FNES	VFNS	COSI	FNSI	VFSI	FABL TEXT	INTB II	FINE CLAY	NON-CLAY	8D1 15-BAR TO CLAY
		2-.05	.05-.002	LT .002	LT .0002	2-1	1-.5	.5-.25	.25-.10	.10-.05	.05-.02	.02-.002	.005-.002	SAND 2-.1	.2-.02	TO CLAY	CLAY	BAR
CM		PCT LT 2MM														PCT	PCT	CLAY
0-16	0A1																	
16-40	0E																	
40-62	0A2																	
62-90	2A1B																	
90-105	2C																	

DEPTH	(PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2) VOL. (- WEIGHT -)						BULK DENSITY			WATER CONTENT			CARBONATE		PH	
	GT 2	GT 75	75-20	20-5	5-2	LT .074	20-2	4A1D 1/3-OVEN DRY	4A1B OVEN DRY	4D1 COLE	4B1C 1/10 BAR	4B1C 1/3-BAR	4B2A 15-BAR	4C1 WRD CM/CM	6E1B LT 2	3A1A LT .002	8C1A 1/1 H2O	8C1E 1/2 CACL
CM	PCT	PCT	(- - - PCT LT 75 - - -)				LT20	G/CC	G/CC		PCT	PCT	PCT	CM	PCT	PCT		
0-16								.18	.39	.308	436	405	86.0	.57				
16-40								.17	.33	.247	484	388	80.0	.52				
40-62								.20	.38	.236	428	414	69.0	.64				
62-90													8.0					
90-105													.8					

DEPTH	(ORGANIC MATTER) 6A1A ORGN CARB	6E1A NITG	C/N	IRON 6C2B EXT FE	PHOS TOTL	(- EXTRACTABLE BASES 5B4A- -) 6N2E CA	6O2D MG	6P2B NA	6Q2B K	SUM EXTB	ACTY 6H1A BACL TEA	AL 6G1E KCL EXT	(CAT EXCH) 5A3A EXTB ACTY	5A6A NHAC	RATIO 8D1 NHAC TO CLAY	RATIO 8D3 CA TO MG	CA 5F1 SAT NHAC	(BASE SAT) 5C3 EXTB ACTY	5C1 NHAC
CM	PCT	PCT		PCT	PCT	(- - - - - - - - - - MEQ / 100 G - - - - - - - - - -)									CLAY	MG	PCT	PCT	PCT
0-16	50.1					133.0	42.3	.9	.7	177.0	39.5		216.0	149.0		3.1	89	82	119
16-40	53.7					106.0	33.1	.6	.4	140.0	52.0		192.0	136.0		3.2	78	73	103
40-62	51.2					120.0	31.5	.5	.4	152.0	49.8		202.0	152.0		3.8	79	75	100
62-90	1.57					10.4	2.9	.1	.3	13.7	1.8		15.5	13.6		3.6	76	88	101
90-105	.16					1.1	.4	.1	.1	1.7	.0		1.7	1.3			85	100	131

DEPTH	(SATURATED PASTE) 8E1 REST OHM- CM	8C1B PH	8A H2O PCT	NA 5D2 ESP PCT	NA 5E SAR	SALT 8D5 TOTL SOLU PPM	GYP 6F1A PCT	(- SATURATION EXTRACT 8A1- 8A1A EC MMHOS/CM	6N1B CA	6O1B MG	6P1B NA	6Q1B K	6I1A CO3	6J1A HCO3	6K1A CL	6L1A SO4	6N1A NO3	ATTERBERG 4F1 LQID LMIT	4F2 PLST INDX
CM			PCT	PCT				CM	(- - - - - - - - - MEQ / LITER - - - - - - - - -)									PCT	
0-16	950	5.6	689.0			8700		1.87	13.3	10.5	.5	.3	0	.2	0	14.9	8.5		
16-40	1200	5.5	792.0			7100		1.40	9.8	6.8	.3	.2	0	.2	0	9.3	6.4		
40-62	1100	5.4	666.0			6000		1.40	9.8	5.8	.2	.2	0	.9	0	12.6	4.4		
62-90	6500	6.2	29.2	1		130		.68	3.7	2.6	.2	.2	0	0	0	3.1	2.9		
90-105	11000	6.7	24.1	8		70		.44	2.1	1.7	.2	.2	0	0	0	2.1			

DEPTH	(- - - - - - - - - - - - - - - HISTOSOL CHARACTERIZATION- - - - - - - - - - - - - - -) (STATE OF DECOMPOSITION) 8F RUBB CONT	8G (FIBER VOL) UNRB	RUB	8H PYROPHOSPHT SOLUBILITY	PH .01M CACL	(BULK DEN) 4A3A FILD 1/3B STAT G/CC	4A1I REWT G/CC	COLE 4D1 RE-WET	SUBS RES-IDUE PCT	(- WATER CONTENT- -) 4B4 FILD STAT PCT	4B1C 1/3B REWT PCT	4B2 15-BAR PCT	8C1 WRD CM/CM
CM	PCT	PCT	PCT						PCT	PCT	PCT	PCT	
0-16	14	42	8	10YR 6/3	6.2	.21			51	359		88.0	
16-40	17	62	18	10YR 6/3	5.8	.20			77A	373		81.0	
40-62	53	10	2	10YR 2/2	5.6	.22			56	341		88.0	
62-90										19		2.7	
90-105										12		.7	

(A) COMPUTED AS HALF SURFACE AND HALF SUBSURFACE.

Pedon classification: Terric Borosaprist; sandy or sandy-skeletal, mixed, euic.
Series classification: Same.
Soil: Markey series.
Soil No.: S72MN-35-3.
Location: Kittson County, Minnesota; SW ¼, NW ¼, Sec. 20, T. 161 N., R. 45 W. About 48.8 deg. north latitude and about 97.5 deg. west longitude.
Climate: Humid continental. Mean annual temperature is 38 deg. F.; mean summer temperature is 66 deg. F., and mean winter temperature is 6 deg. F. Mean annual precipitation is 20 inches; mean May through September precipitation is 14 inches; total annual snowfall is about 35 inches. Frost-free period is about 110 days.
Parent material: Organic soil material derived primarily from herbaceous plants over sandy lacustrine sediments of Glacial Lake Agassiz.
Physiography: Central lowlands; Lake Agassiz Plain; area is nearly level and local relief is mostly less than 5 feet. Elevation is about 1,015 feet.
Vegetation: Mostly sedges and grasses. The area has been burned many times.
Size of bog: Several hundred acres.
Distance to adjacent mineral land: About 300 feet. **Microrelief:** Very slight.
Depth to water table: About 62 cm. **Subsidence:** Slight.
Described and sampled by: D. D. Barron, J. O. Nordin, R. S. Farnham, W. E. McKinzie, W. C. Lynn, and H. R. Finney on July 27, 1972. Samples were obtained from a pit that was dug with a spade.

Oa1 721615 0 to 16 cm Black (10YR 2/1, broken face and rubbed) sapric material; about 30 percent fiber, about 5 percent rubbed; weak fine crumb structure; very friable; herbaceous fiber; about 15 percent mineral material; pH 5.0; clear smooth boundary.

Oe 721616 16 to 40 cm Black (10YR 2/1, broken face and rubbed) matrix with dark brown (7.5YR 3/2, broken face) fiber, hemic material; about 60 percent fiber, about 20 percent rubbed; weak thin platy structure; nonsticky; herbaceous fiber; about 10 percent mineral material; pH 5.3; gradual smooth boundary.

Oa2 721617 40 to 62 cm Black (10YR 2/1, broken face and rubbed) sapric material; about 35 percent

SOIL CLASSIFICATION-TYPIC HAPLAQUOLL
FINE, MONTMORILLONITIC, MESIC
SERIES - - - - - - - -MARNA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, MTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

SOIL NO - - - - - - - S69MN-7-1 COUNTY - - - BLUE EARTH

GENERAL METHODS- - -1A, 1B1B, 2A1, 2B SAMPLE NOS. 69B766-69B772 (A) 69L941-69L947 JULY 1976

DEPTH CM	HORIZON	SAND 2-.05	SILT .05-.002	CLAY LT .002	FINE CLAY LT .0002	VCOS 2-1	CORS 1-.5	MEDS .5-.25	FNES .25-.10	VFNS .10-.05	COSI .05-.02	FNSI .02-.002	VFSI .005-.002	FAML TEXT SAND 2-.1	INTR II .2-.02	FINE CLAY TO CLAY PCT	NON-CO3-CLAY PCT	RATIO 8D1 15-BAR TO CLAY
		(PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B) PCT LT 2MM				SAND					SILT							
000-23	AP	12.6	45.8	41.6	26.6	0.2	0.7	1.1	4.9	5.7	11.7	34.1	10.3	6.9	20.8	64		0.47
023-33	A12	11.4	48.9	39.7	26.6	0.3	0.5	1.3	5.4	3.9	13.1	35.8		7.5	20.7	67		0.50
033-46	A3	12.3	44.1	43.6	28.5	0.3	0.7	1.1	4.9	5.3	10.5	33.6	8.5	7.0	19.2	65		0.46
046-56	B1G	11.0	43.4	45.6	27.8	0.2	0.6	1.0	4.4	4.9	9.9	33.5	13.5	6.4	15.0	53		0.44
056-71	B2G	10.9	43.0	46.1	24.6	0.3	0.6	1.1	4.4	4.5	7.4	35.6		6.4	15.0	53		0.44
071-105	2C1G	23.9	42.1	34.0	11.8	1.8	2.7	3.1	9.5	6.8	9.0	33.1	12.6	17.1	21.8	35		0.50
105-140	2C2G	35.1	39.3	25.6	9.6	1.1	3.7	5.2	15.6	9.6	11.1	28.2		25.5	30.8	38		0.56

DEPTH CM	VOL. GT 2 PCT	GT 75 PCT	75-20	20-5	5-2	LT .074	20-2 PCT LT20	4A1D 1/3-BAR G/CC	4A1H OVEN DRY G/CC	4D1 COLE	4B1C 1/10 BAR PCT	4B1C 1/3-BAR PCT	4B2 15-BAR PCT	4C1 WRD CM/CM		CARBONATE 6E1B LT 2 PCT	3A1A LT .002 PCT	PH 8C1A 1/1 H2O	PH 8C1E 1/2 CACL
	(PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2)	WEIGHT	(PCT LT 75)					(BULK DENSITY)			(WATER CONTENT)								
000-23	TR	0	0	0	TR	91		1.25	1.33	.021	36.5	36.1	19.4	.21	2.18			5.8	
023-33	TR	0	0	0	TR	90		1.35	1.74	.088	33.9	32.0	19.7	.17				6.0	
033-46	TR	0	0	0	TR	91		1.26	1.72	.109	35.8	33.8	20.0	.17				6.0	
046-56	TR	0	0	0	TR	92		1.22	1.65	.106	35.6	34.5	20.3	.17				6.7	
056-71	TR	0	0	0	TR	92		1.27	1.43	.040	34.1	32.6	20.3	.15	1.78	3		7.7	
071-105	1	0	0	1	2	78		1.27	1.49	.054	34.7	34.8	16.9	.23	1.98	17		7.9	
105-140	1	0	TR	TR	1	69		1.32	1.44	.029	33.0	32.5	14.4	.24	1.88	12		7.9	

DEPTH CM	ORGANIC MATTER 6A1A ORGN CARB PCT	6B1A NITG PCT	C/N	IRON 6C2B EXT FE PCT	PHOS 6S1A TOTL PCT	EXTRACTABLE BASES 5B4A 6N2E CA	6O2D MG	6P2B NA	6Q2B K	SUM EXTB	ACTY 6H2A BACL TEA	AL 6G1D KCL EXT	CAT EXCH 5A3A EXTB ACTY	5A6A NHAC	RATIO 8D1 NHAC TO CLAY	RATIO 8D3 CA TO MG	CA 5F SAT NHAC PCT	BASE SAT 5C3 EXTB ACTY PCT	5C1 NHAC PCT
						(MEQ / 100 G)													
000-23	3.33C	0.273	12	0.6		29.9	11.2	0.1	0.5	41.7	10.3		52.0	41.7	1.00	2.7	72	80	100
023-33	3.59	0.263	14	0.6		29.9	11.0	0.1	0.4	41.4	9.7		51.1	41.4	1.04	2.7	72	81	100
033-46	1.94	0.164	12	0.5		28.8	12.7	0.1	0.5	42.1	7.4		49.5	40.3	0.92	2.3	71	85	104
046-56	0.97	0.091	11	0.6		27.4	13.4	0.1	0.5	41.4	4.9		46.3	38.9	0.85	2.0	70	89	106
056-71	0.39			0.6				0.2	0.5					36.0	0.78				
071-105	0.13			0.4				0.3	0.4					23.0	0.68				
105-140	0.26			0.8				0.4	0.4					18.3	0.71				

DEPTH CM	SATURATED PASTE 8E1 REST OHM-CM	8C1B PH	8A H2O PCT	NA 5D2 ESP PCT	NA 5E SAR	SALT 8D5 TOTL SOLU PPM	GYP 6F1A PCT	SATURATION EXTRACT 8A1 8A1A EC MMHOS/CM	6N1B CA	6O1B MG	6P1A NA	6Q1A K	6I1A CO3	6J1A HCO3	6K1A CL	6L1A SO4	6M1A NO3	ATTERBERG 4F1 LQID LMIT PCT	4F2 PLST INDX
									(MEQ / LITER)										
000-23																		53D	20
023-33																			
033-46																			
046-56																		61D	33
056-71																			
071-105	1000	7.5																50D	24
105-140	2000	7.6																	

ANALYSES BY MINNESOTA AGRICULTURAL EXPERIMENT STATION, ST PAUL, MN. MINERALOGY BY X-RAY ANALYSIS. TOTAL PHOSPHORUS BY NITRIC-PERCHLORIC DIGESTION. AVAILABLE PHOSPHORUS BY BRAY'S NO 1 EXTRACTANT.

DEPTH	MONT	VERM	ILLITE	KAOL	QUARTZ	TOTAL P	AVAIL P
	(MINERALOGY PCT LT .002MM)					(LBS/A)	
000-23	60	0	25	10	5	936	23
023-33							16
033-46						762	4
046-56	80	0	10	5	0		2
056-71						770	1
071-105	75	0	15	10	0		1
105-140						868	1

(A) BULK DENSITY AND WATER CONTENT ANALYSES BY THE SOIL SURVEY INVESTIGATIONS UNIT, LINCOLN, NE. UNLESS OTHERWISE INDICATED REMAINING ANALYSES BY THE SOIL SURVEY INVESTIGATIONS UNIT, BELTSVILLE, MD.

(B) MICRO-PENETRATION RESISTANCE - A ROD 0.6 CM DIA IS SLOWLY PUSHED INTO BULK DENSITY CLOD, EQUILIBRATED AT 1/10-BAR, A DISTANCE OF 0.6 CM USING A POCKET PENETROMETER. UNITS ARE FORCE (KG) AND NOT ESTIMATES OF UNCONFINED COMPRESSIVE STRENGTH.

(C) ORGANIC CARBON IS 20 KG/M SQ TO A DEPTH OF 1 M (6A).

(D) LL AND PI BY SOIL MECHANICS LAB, USDA-SCS, LINCOLN, NE

Pedon classification: Typic Haplaquoll; fine, montmorillonitic, mesic.
Series classification: Same.
Soil: Marna series.
Soil No.: S69MN-7-1.
Location: Blue Earth County, Minnesota; SW1/4 of SW1/4, Sec. 23, T. 105 N., R. 28 W. (Shelby Twp.); about 440 feet north and 300 feet east from east side of center of road junction. About 94 deg. 10 min. west longitude and 43 deg. 53 min. north latitude.
Climate: Humid continental. Some characteristics of temperature in deg. F. are: annual normal - 46, winter normal - 17, summer normal - 71; some characteristics of precipitation in inches are: annual normal - 28, May through September - 18, normal annual snowfall - 40.
Parent material: Moderately shallow, fine textured lacustrine sediments over calcareous loam glacial till, (New Ulm) of the Des Moines Lobe, Late Wisconsin age.
Physiography: Central Lowlands; glacial Lake Minnesota Plain in the Blue Earth Till Plain of H. E. Wright (1972).
Landscape setting: Pedon has a level plane slope. General topography is nearly level to gently undulating. Relative relief is about 10 feet in the immediate area. Elevation is about 1,045 feet.
Major associated soils on the landscape near this site are of the Lura, Cuckoon, and Kamman series

[redacted]

Drainage: Poorly drained.
Erosion: Slight.
Permeability: Moderately slow in upper part, moderate in the glacial till.
Described by: R. J. Edwards and H. R. Finney on October 20, 1969.
Sampled by: L. Shields, R. J. Edwards, J. J. Murray, J. F. Cummins, and H. R. Finney on October 20, 1969.

Ap 69B766 0 to 23 cm (0 to 9 inches) Black (10YR 2/1) heavy silty clay loam; weak to moderate very fine subangular blocky structure; firm, slightly plastic to plastic; common roots; abrupt smooth boundary.

A12 69B767 23 to 33 cm (9 to 13 inches) Black (10YR 2/1) heavy silty clay loam; moderate very fine subangular blocky structure; firm, plastic and sticky; common roots; clear smooth boundary.

A3 69B768 33 to 46 cm (13 to 18 inches) Black (10YR 2/1) silty clay; very dark gray (10YR 3/1) rubbed; moderate very fine and fine subangular and angular blocky structure; firm, plastic and sticky; few roots; clear smooth boundary.

B1g 69B769 46 to 56 cm (18 to 22 inches) Very dark gray (10YR 3/1) silty clay; black (10YR 2/1)

SOIL CLASSIFICATION-TYPIC HAPLAQUOLL
FINE-LOAMY, MIXED, MESIC
SERIES - - - - - - -MAXCREEK

SOIL NO - - - - - - S70MN-24-1 COUNTY - - - FREEBORN

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 70L1089-70L1099

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NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B - SAND 2-.05	SILT .05-.002	CLAY LT .002	FINE CLAY LT .0002	VCOS 2-1	CORS 1-.5	MEDS .5-.25	FNES .25-.10	VFNS .10-.05	COSI .05-.02	FNSI .02-.002	VFSI .005-.002	FAML TEXT SAND 2-.1	INTR II .2-.02	FINE CLAY TO CLAY	NON-CO3-CLAY	RATIO 8D1 15-BAR TO CLAY
CM		PCT LT 2MM														PCT	PCT	
000-21	A1P	15.2	56.7	28.1	17.5	.7	3.0	3.5	5.0	3.0	23.7	33.0	7.1	12.2	29.1	62	28	.57
021-33	A12	12.2	57.3	30.5	18.5	.5	2.4	2.8	4.0	2.5	23.4	33.9	7.0	9.7	27.9	61	31	.50
033-54	A3G	8.9	59.3	31.8	20.2	.5	1.7	1.8	2.6	2.3	24.4	34.9	7.1	6.6	28.0	64	32	.47
054-76	B21G	31.3	44.6	24.1	13.7	2.5	5.0	6.1	10.5	7.2	21.3	23.3	5.2	24.1	33.6	57	24	.46
076-105	2B22G	55.1	24.8	20.1	18.7	4.3	10.1	11.9	19.5	9.3	10.8	14.0	4.0	45.8	29.9	93	20	.44
105-132	2C1G	53.7	27.5	18.8	7.9	4.8	10.1	11.3	18.3	9.2	11.8	15.7	4.9	44.5	30.3	42	19	.46
132-160	2C2	56.3	28.8	14.9	6.6	5.3	10.0	11.9	19.3	9.8	13.0	15.8	4.3	46.5	32.7	44	15	.48
160-210	2C3	55.5	29.1	15.4	6.7	4.2	9.4	11.9	19.8	10.2	13.7	15.4	4.0	45.3	33.9	44	15	.45
210-260	2C4	62.9	26.3	10.8	6.0	5.8	13.1	15.3	20.7	8.0	12.6	13.7	3.9	54.9	30.4	56	11	.44
260-305	3C5	57.3	30.0	12.7	7.8	4.0	10.3	12.5	20.2	10.3	15.3	14.7	2.6	47.0	35.8	61	13	.43
305-335	3C6	79.8	13.8	6.4		7.6	35.2	17.7	14.2	5.1	7.6	6.2	1.4	74.7	18.9		6	.38

DEPTH	PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2 VOL. GT 2	WEIGHT GT 75	75-20	20-5	5-2	LT .074	2D-2	BULK DENSITY 4A1D	4A1H	4D1	WATER CONTENT 4B1C	4B1C	4B2	4C1	CARBONATE 6E1B LT 2	3A1A LT .002	PH 8C1A	8C1E
CM	PCT	PCT	PCT LT 75				LT20	1/3-BAR G/CC	OVEN DRY G/CC	COLE	1/10 BAR PCT	1/3-BAR PCT	15-BAR PCT	WRD CM/CM	PCT	PCT	H2O	CACL
000-21	TR	0	0	0	TR	87	TR	1.24	1.49	.065	33.7	31.5	15.9	.20	4.08			5.8	5.7
021-33	TR	0	0	0	TR	89	TR	1.37	1.61	.057	29.8	27.0	15.3	.16	2.68			6.5	6.3
033-54	TR	0	0	0	TR	93	TR	1.34	1.54	.049	28.9	26.7	14.9	.16	2.38			6.8	6.7
054-76	1	0	TR	1	1	72	2	1.38	1.55	.040	26.7	24.1	11.0	.18	2.08			7.1	6.9
076-105	3	0	TR	2	3	47	5	1.54	1.70	.032	19.2	17.5	8.8	.13	2.08		0	7.5	7.0
105-132	3	0	TR	2	3	48	5	1.53	1.65	.024	21.4	19.5	8.7	.16	2.18	6	0	7.8	7.6
132-160	4	0	TR	2	4	46	6	1.70A					7.1			11	0	7.8	7.6
160-210	5	0	TR	4	5	46	9	1.68	1.74	.011	20.2	16.7	7.0	.15		12	0	8.2	7.7
210-260		0	0	3	6	37	9						4.7			11	0	8.3	7.8
260-305		0	0	2	3	46	5						5.5			12	0	8.0	7.7
305-335		0	0	1	4	22	5						2.4			6	0	8.1	7.7

DEPTH	ORGANIC MATTER 6A1A ORGN CARB	6B1A NITG	C/N	IRON 6C2B EXT FE	PHOS TOTL	EXTRACTABLE BASES 5B4A- 6NZE CA	6Q2D MG	6P2B NA	6Q2B K	SUM EXTB	ACTY 6H1A BACL TEA	AL 6G1E KCL EXT	CAT EXCH 5A3A EXTB ACTY	5A6A NHAC	RATIO 8D1 NHAC TO CLAY	RATIO 8D3 CA TO MG	CA 5F1 SAT NHAC	BASE SAT 5C3 EXTB ACTY	5C1 NHAC
CM	PCT	PCT		PCT	PCT	MEQ / 100 G											PCT	PCT	PCT
000-21	3.88C	.332	12	0.7		26.2	7.9	0.5	0.7	35.3	9.6		44.9	35.1	1.25	3.3	75	79	101
021-33	1.84	.159	12	0.7		25.8	8.4	0.4	0.5	35.1	5.1		40.2	32.9	1.08	3.1	78	87	107
033-54	0.52	.061	9	0.9		22.0	8.0	0.3	0.7	31.0	3.4		34.4	28.4	0.89	2.8	77	90	109
054-76	0.24	.029	8	0.8		16.3	6.0	0.2	0.5	23.0	2.5		25.5	21.0	0.87	2.7	78	90	110
076-105	0.12			0.7		13.7	5.0	0.2	0.4	19.3	1.0		20.3	16.3	0.81	2.7	84	95	118
105-132	0.11			0.6		13.7D	3.8D	0.2	0.4	18.1				14.2	0.76				
132-160	0.10			0.5		13.9D	2.8D	0.2	0.3	17.2				10.1	0.68				
160-210	0.11			0.5		13.9D	2.6D	0.2	0.3	17.0				9.4	0.61				
210-260	0.08			0.4		12.3D	2.0D	0.2	0.2	14.7				6.9	0.64				
260-305	0.11			0.5		13.3D	2.3D	0.2	0.2	16.0				8.0	0.63				
305-335	0.06			0.2		5.8D	1.0D	0.1	0.2	7.1				4.0	0.62				

DEPTH	SATURATED PASTE 8E1 REST OHM-	8C1B PH	8A H2O	NA 5D2 ESP	NA 5E SAR	SALT 8D5 TOTL SOLU	GYP 6F1A	SATURATION EXTRACT 8A1- 8A1A EC	6N1B CA	6Q1B MG	6P1B NA	6Q1B K	6I1A CO3	6J1A HCO3	6K1A CL	6L1A SO4	6M1A NO3	ATTERBERG 4F1 LQID LMIT	4F2 PLST INDX
CM	CM		PCT	PCT		PPM	PCT	MMHOS/CM	MEQ / LITER									PCT	
000-21																		50E	21
021-33																			
033-54																			
054-76																		39E	23
076-105	2100	7.0	35.8	1		140		0.62	3.6	1.8	0.5	0.1						32E	19
105-132																			
132-160																			
160-210																		23E	9
210-260																			
260-305																			
305-335																			

ANALYSES BY MINNESOTA AGRICULTURAL EXPERIMENT STATION, ST PAUL, MN. MINERALOGY, X-RAY ANALYSIS. TOTAL PHOSPHORUS, NITRIC-PERCHLORIC DIGESTION. AVAILABLE PHOSPHORUS, BRAY'S NO 1 EXTRACTANT.

DEPTH	MINERALOGY MONT	VERM	ILLITE	KAOL	QUARTZ	TOTAL P	AVAIL P
CM	PCT LT .002 MM					LBS/A	
000-21	45	20	30	5	0	1816	142
021-33	45	20	30	5	0		30
033-54	50	20	25	5	0	700	9
054-76	50	20	25	5	0	928	4
076-105	55	20	20	5	0		4
105-132	55	15	25	5	0	1148	4
132-160	60	15	20	5	0		6
160-210	55	20	20	5	0		7
210-260	50	20	25	5	0	588	7
260-305							
305-335	50	20	5	5	0		

(A) ESTIMATED.
(B) MICRO-PENETRATION RESISTANCE - A ROD 0.6 CM DIA IS SLOWLY PUSHED INTO BULK DENSITY CLOD, EQUILIBRATED AT 1/10-BAR, A DISTANCE OF 0.6 CM USING A POCKET PENETROMETER. UNITS ARE FORCE (KG) AND NOT ESTIMATES OF UNCONFINED COMPRESSIVE STRENGTH.
(C) ORGANIC CARBON IS 16 KG/M SQ TO A DEPTH OF 1 M (6A).
(D) METHOD 6N4C FOR CA AND 6O4C FOR MG.
(E) DETERMINED BY SOIL MECHANICS LAB - SCS, LINCOLN, NE.

Pedon classification: Typic Haplaquoll; fine-loamy, mixed, mesic.
Series classification: Typic Haplaquolls; fine-silty, mixed, mesic.
Soil: Maxcreek taxadjunct*
Soil No.: S70MN-24-1.
Location: Freeborn County, Minnesota; about 4 miles south southeast of Oakland; about 300 feet north and 165 feet east of the southwest corner of the NW 1/4, Sec. 24, T. 102 N., R. 19 W., Oakland Township.
Climate: Humid continental. Some features of temperature in deg. F.: annual normal - 46, summer normal - 70, winter normal - 18; some features of precipitation in inches: annual normal - 30, May through September - 19, annual normal snowfall - 40.
Parent material: Thin loess mantle over loamy calcareous till of the Des Moines Lobe of the Late Wisconsin glaciation.
Physiography: Central Lowlands; Bemis Moraine in Owatonna Moraine Area of H. E. Wright (1970); Northfield-Myrtle Moraine, irregular, rolling (MN Soil Atlas).
Landscape setting: Site has a plain level slope. Topography in the immediate area is nearly level and gently undulating, and relative relief is about 10 feet. Elevation is about 1,220 feet. Major soils in the immediate area are of the Moland, Marton, and Maxcreek series.
Vegetation: Wheat stubble field. Native vegetation was tall grass prairie.
Drainage: Poorly drained.
Erosion: None
Moisture: Moist near wet.
Permeability: Moderate.
Described by: J. F. Cummins on October 22, 1970.
Sampled by: R. B. Groesman, E. R. Gross, R. H. Rust, and J. F. Cummins on October 22, 1970.

Alp 70L1089 0 to 21 cm (0 to 8 inches) Black (10YR 2/1) to (N 2/) silty clay loam; weak fine granular structure; friable; trace of coarse fragments; neutral; abrupt smooth boundary.

A12 70L1090 21 to 33 cm (8 to 13 inches) Black (10YR 2/1) silty clay loam; moderate fine and medium subangular blocky structure; friable; few krotovinas; trace of coarse fragments; a thin plow pan at upper boundary; neutral; clear irregular boundary.

A3g 70L1091 33 to 54 cm (13 to 21 inches) Very dark gray (10YR 3/1) silty clay loam; black (10YR 2/1) and dark gray (10YR 4/1) krotovinas; weak fine and medium subangular blocky structure; friable; few pores; neutral; clear wavy boundary.

B21g 70L1092 54 to 76 cm (21 to 30 inches) Dark gray (2.5Y 4/1) silty clay loam; weak fine and medium prismatic structure parting to moderate fine and medium subangular blocky structure; friable; few Fe-Mn oxide masses; few pores; neutral; clear wavy boundary.

IIB22g 70L1093 76 to 105 cm (30 to 41 inches) Olive gray (5Y 5/2) loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; weak fine and medium prismatic structure parting to moderate fine and medium subangular blocky structure; friable; about 2 percent coarse fragments; few pores; neutral; clear wavy boundary.

IIC1g 70L1094 105 to 132 cm (41 to 52 inches) Olive gray (5Y 5/2) loam; common medium distinct dark yellowish brown (10YR 4/4) and few fine prominent dark brown (7.5YR 3/4) mottles; weak fine and medium prismatic structure parting to moderate fine and medium subangular blocky structure; friable; about 4 percent coarse fragments; few pores; calcareous in parts; clear wavy boundary.

IIC2 70L1095 132 to 160 cm (52 to 63 inches) Olive gray (5Y 5/2) loam or sandy clay loam; many medium distinct dark yellowish brown (10YR 4/4) and few fine prominent dark brown (7.5YR 4/4) mottles; weak fine and medium prismatic structure parting to weak fine and medium subangular blocky structure; friable; about 5 percent coarse fragments; calcareous in parts; clear wavy boundary.

IIC3 70L1096 160 to 210 cm (63 to 83 inches) Grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/4 and 5/6) loam or sandy clay loam; massive with large oblique partings; friable; about 5 percent coarse fragments; calcareous; abrupt wavy boundary.

IIC4 70L1097 210 to 260 cm (83 to 100 inches) (Probe sample) Light olive brown (2.5Y 5/4) sandy clay loam or sandy loam; many coarse prominent yellowish brown (10YR 5/8) and strong brown (7.5YR 5/8) and few medium prominent yellowish red (5YR 5/8) mottles; massive; friable to very friable; about 6 percent coarse fragments; calcareous; abrupt boundary.

IIIC5 70L1098 260 to 305 cm (100 to 117 inches) (Auger sample) Light olive brown (2.5Y 5/4) sandy clay loam or sandy loam; many coarse prominent strong brown (7.5YR 5/8) mottles; massive; very firm; calcareous; abrupt boundary.

IIIC6 70L1099 305 to 335 cm (117 to 129 inches) (Auger sample) Layered light olive brown (2.5Y 5/4) coarse sand; yellowish brown (10YR 5/8) sandy clay loam, coarse sand, loose; sandy clay loam, very firm; weakly calcareous.

Remarks: Samples were collected from a pit that was dug with a backhoe.

*This pedon is a taxadjunct to the Maxcreek series because it has more sand and less silt in the B21g, IIB and IIC horizons.

SOIL CLASSIFICATION: Typic Eregiochrept: coarse-loamy, mixed, frigid

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL Milaca sandy loam SOIL Nos. S63MN-5-3 LOCATION Benton County, Minnesota

SOIL SURVEY LABORATORY Lincoln, Nebraska LAB. Nos. 18877-18885 August 1967

General Methods: 1A, 1B1b, 2A1, 2B

Depth (in.)	Horizon	Size class and particle diameter (mm) 3A1 — Total: Sand (2–0.05)	Total: Silt (0.05–0.002)	Total: Clay (< 0.002)	Sand: Very coarse (2–1)	Sand: Coarse (1–0.5)	Sand: Medium (0.5–0.25)	Sand: Fine (0.25–0.1)	Sand: Very fine (0.1–0.05)	Silt: 0.05–0.02	Silt: Int. III (0.02–0.002)	Int. II (0.2–0.02)	(2–0.1)			Coarse fragments 2A2: 3B1 2-19 Wt. Pct.	3B2 2-19 Vol. Pct.	
		Pct. of < 2 mm																
1-0	O1															-		
0-1	A1	47.7	39.9	12.4	1.9	7.4	10.1	18.9	9.4	16.9	23.0	36.0	38.3			3		
1-4	A21	59.3	34.4	6.3	3.5	9.4	13.0	22.8	10.6	16.0	18.4	38.2	48.7			4		
4-10	A22	62.3	32.6	5.1	3.9	8.9	12.8	25.3	11.4	15.4	17.2	39.5	50.9			15		
10-19	Bw1	69.3	26.0	4.7	7.3	11.9	14.4	24.4	11.3	12.7	13.3	36.2	58.0			20	14	
19-28	Bw2	71.3	21.0	7.7	8.4	12.9	14.9	24.5	10.6	10.2	10.8	33.0	60.7			35	27	
28-40	Bw3	64.3	26.9	8.8	5.7	11.4	13.4	22.3	11.5	12.2	14.7	35.0	52.8			21	16	
40-55	C1x	64.0	26.3	9.7	6.4	12.3	13.3	20.9	11.1	12.3	14.0	34.0	52.9			15	11	
55-72	C2x	66.5	23.7	9.8	6.4	12.7	14.6	22.0	10.8	10.7	13.0	32.4	55.7			16	12	

Depth (in.)	6A1a Organic carbon	6B1a Nitrogen	C/N		Carbonate as $CaCO_3$	Bulk density: 4A1a Field-State	4A1g 1/10-Bar [b]	4A1g 1/10-Bar	4A1b Air-Dry	4B1 COLE	Water content: 4B4 Field-State	4B1c 1/10-Bar	4B2 15-Bar	4C2 1/10-to 15-Bar		pH:		8C1a (1:1)
	Pct.	Pct.			Pct.	g/cc	g/cc	g/cc	g/cc		Pct	Pct.	Pct.	in./in.				
1-0																		
0-1	8.69	0.609	14										18.8					6.4
1-4	1.33	0.112	12										4.7					5.8
4-10	0.34	0.031	11			1.46a					8.6		2.7					5.4
10-19	0.14					1.77	1.49	1.73	1.73	-	5.4	9.8	2.2	0.11				5.5
19-28	0.11					1.84	1.33	1.82	1.84	0.002	7.4	10.7	3.7	0.09				5.8
28-40	0.09					1.85	1.55	1.84	1.86	0.003	4.1	10.5	4.7	0.10				5.9
40-55	0.05					1.86	1.65	1.85	1.87	0.003	7.9	10.9	4.7	0.10				5.9
55-72	0.05					1.93	1.68	1.91	1.94	0.006	7.5	9.3	4.6	0.08				5.9

Depth (in.)	Extractable bases 5H1a: 6N2a Ca	6Q2a Mg	6P2a Na	6Q2a K	Sum	6H1a Ext. Acidity	Cat. Exch. Cap.: 5A3a Sum Cations	5A1a NH_4OAc	6Q1d KCl-Ext. Al						8D3 Ca/Mg		Base saturation: 5C3 Sum Cations	5C1 NH_4OAc
	meq/100 g																Pct.	Pct.
1-0																		
0-1	29.6	5.0	tr	0.4	35.0	12.2	47.2	33.4							5.9		74	105
1-4	6.4	1.3	tr	0.2	7.9	6.7	14.6	10.1							4.9		54	78
4-10	2.3	1.3	tr	0.1	3.7	4.7	8.4	5.0	0.3						1.8		44	74
10-19	2.4	0.8	tr	0.1	3.3	3.4	6.7	4.6									49	72
19-28	4.0	1.7	tr	0.1	5.8	3.6	9.4	6.8							2.4		62	85
28-40	4.3	2.1	0.1	0.1	6.6	3.3	9.9	7.2							2.0		67	92
40-55	4.5	2.3	0.1	0.1	7.0	2.9	9.9	7.3							2.0		71	96
55-72	4.1	2.3	0.1	0.1	6.6	2.8	9.4	7.0							1.8		70	94

Depth (in.)	Ratios to Clay 8D1: NH_4OAc CEC		15-Bar Water		
1-0					
0-1	2.69		1.52		
1-4	1.60		0.75		
4-10	0.98		0.53		
10-19	0.98		0.47		
19-28	0.88		0.48		
28-40	0.82		0.53		
40-55	0.75		0.48		
55-72	0.71		0.47		

a. Core (Method 4A3).
b. Calculated to include volume but not weight of 2- to 19-mm material (Method 3B2).

Soil classification: Typic Fragiochrept; coarse-loamy, mixed, frigid.
Soil: Milaca sandy loam.
Soil Nos.: S63MN-5-3.
Area: Benton County, Minnesota.
Location: NW¼ NW¼ Sec. 33, T38N, R29W, 150 feet from highway into wood pasture - NW from driveway into pasture.
Vegetation: Mixed hardwoods
Parent material: Red till - sandy clay loam
Physiography: Rolling area in ground moraine
Slope: 6 percent
Aspect: North
Erosion: None
Drainage: Well
Permeability: Moderate
Ground water: Deep
Moisture: Dry
Stoniness: Many in profile Described by: W. W. Anderson.
Sampled October 1, 1963, by W. W. Anderson, M. F. Grimes, R. Farnham, M. Ziebell, G. Holmgren and R. L. Juve.

Horizon

01 1 to 0 inches, partly decomposed leaves with some grass, [redacted]

A1
LSL 18878 0 to 1 inches, black (10YR 2/1) and very dark gray (10YR 3/1) fine sandy loam to loam; very friable; smooth abrupt boundary.

A21
LSL 18879 1 to 4 inches, dark gray (10YR 4/1) and dark grayish brown (10YR 4/2) sandy loam; weak to moderate medium and thin platy structure; very friable; pH 5.4; clear smooth boundary.

A22
LSL 18880 4 to 10 inches, dark grayish brown (10YR 4/2) to dark brown (10YR 4/3) grading to brown (10YR - 7.5YR 4/3) with depth; sandy loam; weak to moderate medium and thin platy structure; very friable; pH 5.3; clear smooth boundary.

Bx1
LSL 18881 10 to 19 inches, dark brown (7.5YR 4/3) to reddish brown (5YR 4/3) sandy loam; weak medium platy with moderate medium platy structure in spots; hard, friable to firm, firm in place when moist; vesicular; slightly redder root staining between some of the plates; pH 5.6; gradual boundary.

Bx2
LSL 18882 19 to 28 inches, reddish brown (5YR 4/3-4/4) sandy loam; weak medium platy structure and massive in spots; hard, friable to firm, very firm in place when moist; vesicular; a very few clay films on surface of plates; pH 5.8. Boundary was not described.

Bx3
LSL 18883 28 to 40 inches, dark reddish brown (5YR 3/3) light sandy clay loam with a few large faint dark reddish gray (5YR 4/2) mottles which have reddish brown (5YR 4/4) rings around them; moderate thin and medium platy structure; hard, friable to firm, very firm in place when moist; clay bridging between some sand grains; clay films in some pores and pebble sockets; pH 5.8. Boundary was not described. (This was thought to be a good fragipan.)

C1x
LSL 18884 40 to 55 inches, reddish brown (5YR 4/3) and dark reddish brown (5YR 3/3) light sandy clay loam; moderate thin and medium platy structure; hard, friable to firm, very firm in place when moist; pH 5.6. Boundary was not described.

C2x
LSL 18885 55 to 72 inches, reddish brown (5YR 4/3) light sandy clay loam; moderate thin and medium platy structure; hard, friable to firm, very firm in place when moist.

Hole to 88 inches. No appreciable change.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION: Typic Fragiochrept; coarse-loamy, mixed, frigid

SOIL Milaca loam SOIL Nos. S63 MN-48-1 LOCATION Mille Lacs County, Minnesota

SOIL SURVEY LABORATORY Lincoln, Nebraska LAB. Nos. 18886-18896 August 1967

General Methods: 1A, 1B1b, 2A1, 2B

Depth (in.)	Horizon	Size class and particle diameter (mm) 3A1 — Total: Sand (2–0.05)	Total: Silt (0.05–0.002)	Total: Clay (< 0.002)	Sand: Very coarse (2–1)	Sand: Coarse (1–0.5)	Sand: Medium (0.5–0.25)	Sand: Fine (0.25–0.1)	Sand: Very fine (0.1–0.05)	Silt: 0.05–0.02	Silt: Int. III (0.02–0.002)	Silt: Int. II (0.2–0.02)	(2–0.1)			Coarse fragments 2A2: 3B1 2-19 Wt. Pct.	Coarse fragments 2A2: 3B2 2-19 Vol. Pct.	
		Pct. of < 2 mm																
0-2	Ap	36.4	55.5	8.1	2.4	6.0	7.7	11.7	8.6	30.6	24.9	44.7	27.8			2	1	
2-4	A21	37.1	56.4	6.5	2.0	5.7	7.7	11.8	9.9	33.3	23.1	48.8	27.2			3	2	
4-10	A22	43.5	50.3	6.2	2.9	6.2	8.9	14.8	10.7	29.6	20.7	47.5	32.8			9	5	
10-14	B1	60.8	33.6	5.6	7.0	9.8	11.9	20.6	11.5	18.9	14.7	40.6	49.3			25	17	
14-21	B21	71.2	22.4	6.4	8.1	12.8	14.5	24.3	11.5	11.0	11.4	34.7	59.7			26		
21-32	B22	76.5	17.8	5.7	8.2	14.4	16.8	26.3	10.8	9.2	8.6	33.0	65.7			30	21	
32-41	Bx1	66.3	25.0	8.7	5.2	11.6	14.8	23.5	11.2	11.5	13.5	34.5	55.1			19	14	
41-55	Bx2	63.8	28.2	8.0	5.6	10.2	13.5	23.0	11.5	13.0	15.2	36.3	52.3			14	11	
55-62	C1x	63.4	27.7	8.9	5.5	11.2	13.0	22.1	11.6	12.9	14.8	35.8	51.8			15	11	
62-70	C2x	61.1	30.2	8.7	5.2	9.1	12.0	22.0	12.8	13.5	16.7	37.7	48.3			14	10	
70-80	C3x	65.0	26.4	8.6	7.6	12.3	13.1	20.8	11.2	12.8	13.6	34.8	53.8			15	11	

Depth (in.)	6A1a Organic carbon a	6B1a Nitrogen	C/N		6E2a Carbonate as $CaCO_3$	Bulk density: 4A1a Field-State	4A1g 1/10-Bar b	4A1g 1/10-Bar	4A1b Air-Dry	4B1 COLE	Water content: 4B4 Field-State	4B1c 1/10-Bar	4B2 15-Bar	4C2 1/10-to 15-Bar		pH: 8C1b Sat. Paste		8C1a (1:1)
	Pct.	Pct.			Pct.	g/cc	g/cc	g/cc	g/cc		Pct.	Pct.	Pct.	in./in.				
0-2	5.63	0.421	13			1.14	1.15	1.16c	1.18	0.007	36.0	32.8d	10.7	0.26e				5.7
2-4	0.80	0.076	11			1.52	1.49	1.52	1.52	-	17.8	22.8	3.8	0.28				5.6
4-10	0.46	0.042	11			1.54	1.45	1.53	1.53	-	15.7	17.4	3.2	0.21				5.6
10-14	0.17					1.65	1.34	1.61	1.60		9.9	13.0	3.5	0.12				6.0
14-21	0.11												3.7					6.2
21-32	0.05					1.70	1.34	1.69	1.70	0.002	12.7	11.2	3.6	0.10				6.3
32-41	0.04					1.86	1.58	1.84	1.86	0.003	11.1	10.8	4.4	0.10		5.8		6.4
41-55	0.01					1.94	1.72	1.93	1.96	0.006	11.3	11.6	4.2	0.12				6.6
55-62	0.05					1.92	1.68	1.89	1.90	0.003	9.4	10.6	3.9	0.12				6.9
62-70	0.02				-(s)	1.91	1.68	1.87	1.91	0.006	10.6	12.4	4.3	0.14				7.0
70-80	0.01				-(s)	1.97	1.73	1.94	1.96	0.003	8.6	10.5	3.8	0.12				7.0

Depth (in.)	Extractable bases: 6N2a Ca	6O2a Mg	6P2a Na	6Q2a K	5H1a Sum	6H1a Ext. Acidity	Cat. Exch. Cap.: 5A3a Sum Cations	5A1a NH_4OAc	6C1d KCl-Ext. Al		6C2a Ext. Iron as Fe	8K1 Resistivity	8H1a Elec. Cond.	8B Water at Sat.	8D3 Ca/Mg		Base saturation: 5C3 Sum Cations	5C1 NH_4OAc
	meq/100 g										Pct.	ohms-cm.	mmhos/cm.	Pct.			Pct.	Pct.
0-2	14.0	2.7	0.1	0.3	17.1	13.9	31.0	22.2			0.7				5.2		55	77
2-4	3.8	0.9	tr	0.1	4.8	6.0	10.8	6.9			0.7						44	70
4-10	3.1	0.6	tr	0.1	3.8	5.6	9.4	5.6			0.8						40	68
10-14	3.7	0.7	tr	0.1	4.5	3.0	7.5	5.5			0.9						60	82
14-21	5.0	1.6	0.1	0.1	6.8	3.0	9.8	7.3			0.9				3.1		69	93
21-32	4.1	1.7	0.1	0.1	6.0	2.3	8.3	6.2			0.8				2.4		72	97
32-41	4.6	2.4	0.1	0.1	7.2	2.3	9.5	7.5			0.9	8000	0.17	19.5	1.9		76	96
41-55	4.7	2.7	0.1	0.1	7.6	1.9	9.5	7.4			0.9				1.7		80	103
55-62	4.3	2.8	0.1	0.1	7.3	1.4	8.7	7.1			0.9				1.5		84	103
62-70	4.5	3.0	0.1	0.1	7.7	1.1	8.8	7.4			0.7				1.5		88	104
70-80	3.8	2.6	0.1	0.1	6.6	1.3	7.9	6.4			0.9				1.5		84	103

Depth (in.)	Ratios to Clay 8H1: NH_4OAc CEC	Ext. Iron	15-Bar Water		
0-2	2.74	0.09	1.32		
2-4	1.06	0.11	0.58		
4-10	0.90	0.13	0.52		
10-14	0.98	0.16	0.63		
14-21	1.14	0.14	0.58		
21-32	1.09	0.14	0.63		
32-41	0.86	0.10	0.51		
41-55	0.93	0.11	0.53		
55-62	0.80	0.10	0.44		
62-70	0.85	0.08	0.49		
70-80	0.74	0.10	0.44		

a. 5.9 kg/m² to 60 inches (Method 6A).
b. Calculated to include volume but not weight of 2- to 19-mm material (Method 3B2).
c. 1/3-bar (Method 4A1d).
d. 1/3-bar (Method 4B1c).
e. 1/3- to 15-bar (Method 4C1).

Soil classification: Typic Fragiochrept; coarse-loamy, mixed, frigid.
Soil: Milaca loam.
Soil Nos.: S63MN-48-1.
Area: Mille Lacs County, Minnesota.
Location: NW¼ NE¼ SW¼ Sec. 22, T38N, R27W, 300 feet SW of fence and field road to abandoned farmstead and 350 feet W by NW of pasture gate by abandoned farmstead.
Vegetation: Bluegrass, thistles, scattered oaks
Parent material: Red till - heavy sandy loam.
Physiography: Slope bordering drainageway.
Slope: 4 to 5 percent.
Aspect: South-southwest.
Erosion: None.
Drainage: Well drained.
Permeability: Moderate.
Ground water: Deep.
Moisture: Moist.
Stoniness: Many in profile. Described by: W. W. Anderson.
Sampled October 2, 1963, by W. W. Anderson, M. F. Grimes, R. S. Farnham, G. Holmgren and R. L. Juve.

Horizon	
Ap LSL 18886	0 to 2 inches, black (10YR 2/1) loam to very fine sandy loam; moderate fine granular structure; very friable; pH 5.6; clear smooth boundary.
A21 LSL 18887	2 to 4 inches, very dark grayish brown (10YR 3/2) grading to dark brown (10YR 3/3) loam to very fine sandy loam; weak to moderate medium and thin platy structure; very friable; black (10YR 2/1) wormcasts; pH 5.8; clear smooth boundary.
A22 LSL 18888	4 to 10 inches, brown (10YR 5/3) grading to brown (7.5YR 5/3) with depth loam to very fine sandy loam; very weak medium and thin platy structure; very friable; few very dark gray (10YR 3/1) wormcasts in upper part of horizon; lower part of horizon has slightly coarser sands; pH 5.8; clear smooth boundary.
B1 LSL 18889	10 to 14 inches, reddish brown (5YR 4/4) sandy loam; very weak medium platy breaking to weak medium and fine subangular blocky structure; friable; pH 6.0; clear smooth boundary.
B21 LSL 18890	14 to 21 inches, reddish brown (5YR 4/4) to dark reddish brown (5YR 3/4) sandy loam; weak medium platy breaking to weak fine subangular blocky structure; friable; slightly brittle in place; pH 6.2; clear smooth boundary.
B22 LSL 18891	21 to 32 inches, dark reddish brown (5YR 3/4) weak sandy loam with pockets of loamy sand; weak medium platy breaking to weak fine subangular blocky structure; friable, very slightly brittle in place; pH 6.2; clear smooth boundary.
Bx1 LSL 18892	32 to 41 inches, dark reddish brown (5YR 3/4) sandy clay loam; moderate medium platy structure; firm, brittle; thick and patchy clay skins in rock sockets and upper surface of some of the plates; pH 6.2; clear smooth boundary.
Bx2 LSL 18893	41 to 55 inches, reddish brown (5YR 4/3) sandy loam; moderate to strong thin and medium platy structure; firm; pH 6.4; clear smooth boundary.
C1x LSL 18894	55 to 62 inches, dark brown (7.5YR 3/4) heavy sandy loam; firm with friable pockets; pH 6.4; clear smooth boundary. Structure was not described.
C2x LSL 18895	62 to 70 inches, reddish brown (5YR 4/3) heavy sandy loam; massive; firm; pH 6.4.
C3x LSL 18896	70 to 80 inches, dark brown (7.5YR 4/4) heavy sandy loam; massive; firm; pH 6.4.

SOIL CLASSIFICATION-TYPIC ARGIAQUOLL
FINE, MONTMORILLONITIC, MESIC
SERIES - - - - - - -MINNETONKA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, NTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

SOIL NO - - - - - - S69MN-7-12 COUNTY - - - BLUE EARTH

GENERAL METHODS- - -1A, 1B1B, 2A1, 2B SAMPLE NOS. 69B840-69B848 (A) JULY 1976
69L948-69L951

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B															RATIO
		SAND 2- .05	SILT .05- .002	CLAY LT .002	FINE CLAY LT .0002	SAND VCOS 2- 1	SAND CORS 1- .5	SAND MEDS .5- .25	SAND FNES .25- .10	SAND VFNS .10- .05	SILT COSI .05- .02	SILT FNSI .02- .002	SILT VFSI .005- .002	FAML TEXT SAND 2-.1	INTR II .2- .02	FINE CLAY TO CLAY	NON- CO3- CLAY	8D1 15- BAR TO CLAY
CM		PCT LT 2MM														PCT	PCT	
000-23	AP	21.6	48.1	30.3	16.8	1.4	2.6	3.3	7.8	6.5	16.1	32.0	10.0	15.1	27.3	55		0.52
023-33	A12	20.4	46.7	32.9	17.8	1.1	2.2	3.2	7.6	6.3	15.4	31.3		14.1	26.4	54		0.48
[redacted]																		
048-59	B21TG	25.3	40.2	34.5		1.2	3.2	4.3	9.5	7.0	11.7	28.5	10.6	18.3	24.4			0.48
059-79	B22TG	24.0	38.7	37.3	22.1	1.3	3.0	3.9	9.0	6.9	11.4	27.3	9.8	17.1	23.7	59		0.48
079-102	B23TG	22.3	37.2	40.5	25.1	2.1	2.9	3.2	7.6	6.5	10.4	26.8		15.8	21.7	62		0.47
102-122	2B3TG	25.9	35.4	38.7	21.7	1.8	3.2	3.9	9.3	7.7	9.5	25.9		18.2	23.1	56		0.51
122-138	2C1G	31.4	34.6	34.0	14.5	1.9	4.3	5.1	10.9	9.2	9.4	25.2		22.2	25.6	43		0.32
138-168	2C2G	32.4	44.8	22.8		2.0	3.0	4.2	12.7	10.5	9.5	35.3	12.7	21.9	28.2			0.61

DEPTH	PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2 VOL. GT 2	WEIGHT GT 2	WEIGHT 75-20	WEIGHT 20-5	WEIGHT 5-2	WEIGHT LT .074	BULK DENSITY 4A1D 1/3-	BULK DENSITY 4A1M OVEN DRY	BULK DENSITY 4D1 COLE	WATER CONTENT- 4B1C 1/10	WATER CONTENT- 4B1C 1/3-	WATER CONTENT- 4B2 15-	WATER CONTENT- 4C1 WRD	CARBONATE 6E1B LT	CARBONATE 3A1A LT	PH 8C1A 1/1	PH 8C1E 1/2
		75				.074	20-2								.002		
CM	PCT	PCT	PCT LT 75				LT20	G/CC	G/CC		BAR PCT	BAR PCT	BAR PCT	CM/ CM		PCT		H2O	CACL
000-23	TR	0	0	TR	1	82		1.208					15.7					6.0	
023-33	TR	0	0	TR	1	83		1.23	1.42	0.050	32.3	31.6	15.8	0.20	2.9C			5.9	
033-48	TR	0	0	TR	1	78		1.208					15.6					5.6	
048-59	1	0	0	1	2	77		1.308					16.4					5.3	
059-79	TR	0	0	1	1	79		1.308					17.8					5.3	
079-102	1	0	0	1	2	80		1.37	1.76	0.086	30.6	29.8	18.9	0.15				5.4	
102-122	1	0	1	TR	1	78		1.26	1.52	0.066	36.6	35.8	19.7	0.21	1.2C			6.4	
122-138	2	0	1	1	2	72		1.308					17.6			7		7.6	
138-168	1	0	0	2	2	72		1.37	1.46	0.021	30.1	29.0	13.9	0.20	1.8C	15		7.8	

DEPTH	ORGANIC MATTER 6A1A ORGN CARB	6B1A NITG	C/N	IRON 6C2B EXT FE	PHOS 6S1A TOTL	EXTRACTABLE BASES 5B4A- 6N2E CA	6O2D MG	6P2B NA	6Q2B K	SUM EXTB	ACTY 6H2A BAGL TEA	AL 6G1D KCL EXT	(CAT EXCH) 5A3A EXTB ACTY	5A6A NHAC	RATIO 8D1 NHAC TO CLAY	RATIO 8D3 CA TO MG	CA 5F SAT NHAC PCT	(BASE SAT) 5C3 EXTB ACTY PCT	5C1 NHAC PCT
CM	PCT	PCT		PCT	PCT	MEQ / 100 G													
000-23	3.33D	0.264	13																
023-33	3.35	0.246	14																
033-48	1.81	0.136	13																
048-59	1.19	0.105	11																
059-79	0.91																		
079-102	0.78																		
102-122	0.52																		
122-138	0.26																		
138-168	0.39																		

DEPTH	SATURATED PASTE 8E1 REST OHM-	8C1B PH	8A H2O	NA 5D2 ESP	NA 5E SAR	SALT 8D5 TOTL SOLU	GYP 6F1A	SATURATION EXTRACT 8A1- 8A1A EC	6N1B CA	6O1B MG	6P1A NA	6Q1A K	6I1A CO3	6J1A HCO3	6K1A CL	6L1A SO4	6M1A NO3	ATTERBERG 4F1 LQID LMIT	4F2 PLST INDX
CM	CM		PCT	PCT		PPM	PCT	MMHOS/ CM	MEQ / LITER									PCT	
000-23																			
023-33																			
033-48																			
048-59																			
059-79																			
079-102	3000	5.3																	
102-122	2000	6.3																	
122-138	2000	7.5																	
138-168	3000	7.6																	

ANALYSES BY MINNESOTA AGRICULTURAL EXPERIMENT STATION, ST PAUL, MN. MINERALOGY BY X-RAY ANALYSIS. TOTAL PHOSPHORUS BY NITRIC-PERCHLORIC DIGESTION. AVAILABLE PHOSPHORUS BY BRAY'S NO 1 EXTRACTANT.

DEPTH	MINERALOGY MONT	VERM	ILLITE	KAOL	QUARTZ	TOTAL P	AVAIL P
	PCT LT .002MM					LBS/A	
000-23	65		25	10	0	1200	18
023-33							15
033-48						868	11
048-59							11
059-79	75	0	15	5	5	722	14
079-102							8
102-122							5
122-138						1028	6
138-168							3

(A) BULK DENSITY AND WATER CONTENT ANALYSES BY THE SOIL SURVEY INVESTIGATIONS UNIT, LINCOLN, NE. UNLESS OTHERWISE INDICATED REMAINING ANALYSES BY THE SOIL SURVEY INVESTIGATIONS UNIT, BELTSVILLE, MD.

(B) ESTIMATED.

(C) MICRO-PENETRATION RESISTANCE - A ROD 0.6 CM DIA IS SLOWLY PUSHED INTO BULK DENSITY CLOD, EQUILIBRATED AT 1/10-BAR, A DISTANCE OF 0.6 CM USING A POCKET PENETROMETER. UNITS ARE FORCE (KG) AND NOT ESTIMATES OF UNCONFINED COMPRESSIVE STRENGTH.

(D) ORGANIC CARBON IS 23 KG/M SQ TO A DEPTH OF 1 M (6A).

Pedon classification: Typic Argiaquoll; fine, montmorillonitic, mesic.
Series classification: Same.
Soil: Minnetonka series.
Soil No.: 69MN-7-12.
Location: Blue Earth County, Minnesota; SE1/4 of SW1/4, Sec. 34, T. 108 N., R. 26 W. (Mankato Twp.); about 200 feet north and 100 feet west of the southeast corner of the southeast 1/4. About 93 deg. 57 min. west longitude and 44 deg. 7 min. north latitude.
Climate: Humid continental. Some characteristics of temperature in deg. F. are: annual normal - 46, winter normal - 17, summer normal - 71; some characteristics of precipitation in inches are: annual normal - 28, May through September - 18, normal snowfall - 40.
Parent material: Moderately deep, fine textured lacustrine sediments over calcareous, loamy glacial till (New Ulm), Des Moines Lobe, Late Wisconsin age.
Physiography: Central Lowlands; glacial Lake Minnesota Plain in the Blue Earth Till Plain of H. E. Wright (1972).
Landscape setting: About 1/2 percent, slightly convex slope. General topography is nearly level with few slight rises and depressions. Relative relief in the immediate vicinity is about 5 feet, but the nearby Le Sueur River is incised about 120 feet into the plain. Elevation at the site is about 1,000 feet. Major associated soil on the landscape near the site is the Shorewood series.
Vegetation: Recently plowed grass-legume field. Native vegetation probably was tall grass prairie later succeeded by mixed hardwood forest.

[redacted]

Erosion: Slight.
Permeability: Moderately slow in upper part, moderate in the glacial till.
Described by: R. J. Edwards and H. R. Finney on October 24, 1969.
Sampled by: L. Shields, R. J. Edwards, J. F. Cummins, J. J. Murray, and H. R. Finney on October 24, 1969.

Ap 69B840 0 to 23 cm (0 to 9 inches). Black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate very fine subangular blocky structure; friable, plastic and slightly sticky; common

[redacted]

Pedon classification: Typic Argiaquoll; fine, montmorillonitic, mesic.
Series classification: Same.
Soil: Minnetonka series.
Soil No.: 69MN-7-12.
Location: Blue Earth County, Minnesota; SE1/4 of SW1/4, Sec. 14, T. 108 N., R. 26 W. (Mankato Twp.); about 200 feet north and 100 feet west of the southeast corner of the southeast 1/4. About 93 deg. 57 min. west longitude and 44 deg. 7 min. north latitude.
Climate: Humid continental. Some characteristics of temperature in deg. F. are: annual normal - 46, winter normal - 17, summer normal - 71; some characteristics of precipitation in inches are: annual normal - 28, May through September - 18, normal snowfall - 40.
Parent material: Moderately deep, fine textured lacustrine sediments over calcareous, loamy glacial till (New Ulm), Des Moines Lobe, Late Wisconsin age.
Physiography: Central lowlands; glacial Lake Minnesota Plain in the Blue Earth Till Plain of H. E. Wright (1972).
Landscape setting: About 1/2 percent, slight convex slope. General topography is nearly level with few slight rises and depressions. Relative relief in the immediate vicinity is about 5 feet, but the nearby Le Sueur River is incised about 120 feet into the plain. Elevation at the site is about 1,000 feet. Major associated soil on the landscape near the site is the Shorewood series.
Vegetation: Recently plowed grass-legume field. Native vegetation probably was tall grass prairie later succeeded by mixed hardwood forest.
Drainage: Poorly drained.
Erosion: Slight.
Permeability: Moderately slow in upper part, moderate in the glacial till.
Described by: R. J. Edwards and H. R. Finney on October 24, 1969.
Sampled by: L. Shields, R. J. Edwards, J. F. Cummins, J. J. Murray, and H. R. Finney on October 24, 1969.

Remarks: Colors are for moist soil. These samples were obtained from a pit with approximate dimensions of 1 x 3 x 2 m in depth.

Micromorphological studies were made on the B21tg, B22tg, and B23tg horizons by Gabriella Carmean under the direction of R. H. Rust. A brief summary of her findings using Brewer's terminology follows:

B21tg horizon
The plasma presents a vosepic fabric, with no special orientation, mostly flecked. The skeleton is 22 percent of the volume, some of it in alteration, with no cutans around the skeleton grains. The voids are generally metavoids, chambers and vughs, connected with narrow channels and are about 11 percent of the volume. There are very thin argillans on the narrow channel walls. In the matrix there are ferromanganous separations as irregular nodules and in some parts of the matrix

SOIL CLASSIFICATION-TYPIC BOROHEMIST
EUIC
SERIES - - - - - - - - MOOSELAKE

SOIL NO - - - - - - - S72MN-36-3 COUNTY - - - KOOCHICHING

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 72L600-72L603

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, MTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

MARCH 1977

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B													RATIO	
					FINE	SAND					SILT		FAML	INTR	FINE	NON- 8D1
		SAND	SILT	CLAY	CLAY	VCOS	CORS	MEDS	FNES	VFNS	COSI	FNSI	VFSI	TEXT	II	CLAY CO3- 15-
		2-	.05-	LT	LT	2-	1-	.5-	.25-	.10-	.05	.02	.005-	SAND	.2-	TO CLAY BAR
		.05	.002	.002	.0002	1	.5	.25	.10	.05	.02	.002	.002	2-.1	.02	CLAY TO
CM		PCT									LT 2MM					PCT PCT CLAY
000-014	OI															
014-035	OE															
035-110	OA1															
110-170	OA2															

DEPTH	PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2					BULK DENSITY			WATER CONTENT				CARBONATE	PH	
	VOL.	WEIGHT				4A1D	4A1H	4D1	4B1C	4B1C	4B2A	4C1	6E1B	3A1A	8C1A 8C1E
	GT	GT	75-20	20-5	5-2	LT	20-2	1/3-	OVEN	COLE	1/10	1/3-	15-	WRD	LT	LT	1/1 1/2
	2	75				.074	PCT	BAR	DRY		BAR	BAR	BAR	CM/	2	.002	H2O CACL
CM	PCT	PCT	PCT LT 75			LT20	G/CC	G/CC			PCT	PCT	PCT	CM	PCT	PCT	
000-014																	
014-035													98				
035-110																	
110-170																	

DEPTH	ORGANIC MATTER			IRON	PHOS	EXTRACTABLE BASES 5B4A					ACTY	AL	CAT EXCH		RATIO	RATIO	CA	BASE SAT	
	6A1A	6B1A	C/N	6C2B		6N2E	6Q2D	6P2B	6Q2B		6H1A	6G1E	5A3A	5A6A	8D1	8D3	5F1	5C3	5C1
	ORGN	NITG		EXT	TOTL	CA	MG	NA	K	SUM	BACL	KCL	EXTB	NHAC	NHAC	CA	SAT	EXTB	NHAC
	CARB			FE						EXTB	TEA	EXT	ACTY		TO	TO	NHAC	ACTY	
CM	PCT	PCT		PCT	PCT	MEQ / 100					G				CLAY	MG	PCT	PCT	PCT
000-014	50.7					18.4	12.2	.5	1.8	32.9	115		148	103		1.5	18	22	32
014-035	53.4					21.0	12.2	.3	.9	34.4	136		170	116		1.7	18	20	30
035-110																			
110-170																			

DEPTH	SATURATED PASTE			NA	NA	SALT	GYP	SATURATION EXTRACT 8A1								ATTERBERG	
	8E1	8C1B	8A	5D2	5E	8D5	6F1A	8A1A	6N1B	6Q1B	6P1B	6Q1B	6I1A	6J1A	6K1A	6L1A	6M1A	4F1	4F2
	REST	PH	H2O	ESP	SAR	TOTL		EC	CA	MG	K		CO3	HCO3	CL	SO4	NO3	LQID	PLST
	OHM-					SOLU		MMHOS/										LMIT	INDX
CM	CM		PCT	PCT		PPM	PCT	CM	MEQ / LITER									PCT	
000-014	8300	3.7	1443			1200		.13	.2	.3	TR	.3	0	0	0	0			
014-035	9600	3.5	885			510		.09	.3	.4	TR	.1	0	0	0	0			
035-110																			
110-170																			

Pedon classification: Typic Borohemist; euic.
Soil: Mooselake series.
Soil No.: S72MN-36-3.
Location: Koochiching County, Minnesota; Big Falls Experimental Forest; SE ¼, SE ¼, Sec. 14, T. 68 N., R. 27 W. About 48.5 deg. north latitude and about 94.2 deg. north longitude.
Climate: Humid continental. Mean annual temperature is 37 deg. F.; mean summer temperature is 64 deg. F.; mean winter temperature is 8 deg. F. Mean annual precipitation is 24 inches; mean May through September precipitation is 16 inches; total annual snowfall is about 55 inches. Frost-free period is about 100 days.
Parent material: Organic soil material derived from woody, herbaceous, and mossy plants over medium textured glacial lacustrine sediments.
Physiography: Central lowlands; Agassiz Lacustrine Plain (Big Fork Valley). Area is nearly level and local relief is mostly less than 5 feet. Elevation is about 1,200 feet.
Vegetation: Black spruce forest with about 40 percent crown cover. Sparse woody understory of labrador tea, leatherleaf, and lingonberry. The ground cover is mixed hypnum and sphagnum mosses. Basal area is about 120 sq. ft /acre. Site-index of black spruce is 29.
Size of bog: Several thousand acres - the Lake Agassiz peatlands.
Distance to adjacent mineral land: About 800 feet to low rise of mineral land that is about 50 acres in size. The mineral land is completely surrounded by peatland.
Microrelief: Common hummocks as much as 1 foot in height.
Depth to water table: At soil surface. **Subsidence:** None.
Observers: Described and sampled by R. S. Farnham, W. E. McKinzie, H. R. Finney, and W. C. Lynn. Tree growth measurements by E. R. Amborn and W. F. Johnston. Both operations were performed on July 25, 1972. Samples were obtained with the Macaulay peat sampler and with a spade (for the upper layers).

Oi 72L600 0 to 14 cm Brown (10YR 4/3, broken face and rubbed) fibric material, light yellowish brown (10YR 6/4, pressed); about 85 percent fiber, about 65 percent rubbed; massive; sphagnum moss fiber; few woody fragments; few thin discontinuous sapric layers; about 8 percent mineral material; gradual boundary.

Oe 72L601 14 to 35 cm Very dark grayish brown (10YR 3/2, broken face, rubbed, and pressed) hemic material; about 60 percent fiber, about 20 percent rubbed; massive; mixed sphagnum moss and herbaceous fiber; trace of woody fragments; about 20 percent mineral material; gradual boundary.

Oa1 72L602 35 to 110 cm Very dark brown (10YR 2/2, broken face, rubbed, and pressed) sapric material; about 40 percent fiber, about 15 percent rubbed; massive; woody fiber; few thin reddish layers with as much as 80 percent woody fibers and fragments; few thin black (10YR 2/1) sapric layers; about 25 percent mineral material; gradual boundary.

Oa2 72L603 110 to 170 cm Black (10YR 2/1, broken face and rubbed) sapric material; about 20 percent fiber, about 5 percent rubbed; massive; mixed herbaceous and woody fiber; two thin layers containing mostly woody fiber and fragments; about 35 percent mineral material in upper part increasing to about 50 percent in lower part; abrupt boundary.

IIA'1b (not sampled) 170 to 175 cm Black (N 2/) sandy clay loam; massive; slightly sticky; abrupt boundary.

IICg (not sampled) 175 to 185 cm Greenish gray (5GY 5/1) sandy clay loam; slightly sticky.

Remarks: Samples for determination of bulk density were collected at depths of 0-14, 25-30, 30-35, and 130-145 (153 cc), the latter with the Macaulay sampler. Bulk samples were collected at depths of 0-14, 14-35, 35-110, and 110-175 cm. Samples primarily for determination of fiber content were collected at depths of 0-14, 14-35, 35-50, 80-85, 120-125, 130-135, and 150-155 cm. The 35 to 110 cm layer qualifies as hemic material according to laboratory analyses.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL Bock fine sandy loam SOIL Nos. S63MN-5-1 LOCATION Benton County, Minnesota

SOIL SURVEY LABORATORY Lincoln, Nebraska LAB. Nos. 18848-18856 August 1967

General Methods: 1A, 1B1b, 2A1, 2B

Depth (In.)	Horizon	Size class and particle diameter (mm) 3A1 — Total: Sand (2–0.05)	Total: Silt (0.05–0.002)	Total: Clay (< 0.002)	Sand: Very coarse (2–1)	Sand: Coarse (1–0.5)	Sand: Medium (0.5–0.25)	Sand: Fine (0.25–0.1)	Sand: Very fine (0.1–0.05)	Silt: 0.05–0.02	Silt: Int. III (0.02–0.002)	Int. II (0.2–0.02)	(2–0.1)			Coarse fragments 2A2: 3B1 2-19 Wt. Pct.	3B2 2-19 Vol. Pct.	
		Pct. of < 2 mm																
0-6	Ap	49.0a	38.1	12.9	1.1	6.6	11.5	19.7	10.1	17.7	20.4	37.5	38.9			2	1	
6-10	A21g	50.4a	38.3	11.3	2.1	6.9	11.3	19.6	10.5	17.5	20.8	37.8	39.9			2	1	
10-13	A22g	52.7a	36.0	11.3	2.1	6.1	10.8	21.7	12.0	17.3	18.7	40.7	40.7			14	9	
13-18	A & B	55.6a	31.5	12.9	3.2	5.8	10.6	22.9	13.1	15.2	16.3	40.6	42.5			13	9	
18-30	B2	61.0a	29.0	10.0	3.2	8.1	12.4	24.3	13.0	13.5	15.5	39.0	48.0			15	10	
30-37	Bc1	62.0	30.0	8.0	4.0	8.7	12.9	23.6	12.8	14.6	15.4	39.6	49.2			12	8	
37-45	Bc2	60.3	33.2	6.5	2.5	7.3	12.0	24.3	14.2	16.3	16.9	43.2	46.1			10	7	
45-60	C1x	60.7b	32.2	7.1	3.8	8.5	12.4	23.3	12.7	15.0	17.2	39.8	48.0			11	8	
60-76	C2x	59.6b	32.0	8.4	4.4	8.4	12.1	22.2	12.5	14.4	17.6	38.5	47.1			12	9	

Depth (In.)	6A1a Organic carbon c Pct	6B1a Nitrogen Pct.	C/N	Carbonate as CaCO3: 6E1b 6E2a <2mm. Pct.	Carbonate as CaCO3: 3A1a <0.002 mm. Pct.	Bulk density: 4A1a Field State g/cc	4A1d 1/3-bar d g/cc	4A1d 1/3-bar g/cc	4A1b Air-dry g/cc	4D1 COLE	Water content: 4B4 Field State Pct.	4B1c 1/3-bar Pct.	4B2 15-bar Pct	4C1 1/3- to 15-bar in./in.		pH: 8C1b Sat. Paste		8C1a (1:1)
0-6	3.52	0.286	12			1.21	1.23	1.24	1.29	0.014	29.6	27.9	10.2	0.22				5.5
6-10	1.34	0.095	14			1.60	1.58	1.60	1.60	-	16.0	17.2	6.0	0.18				5.3
10-13	0.48	0.040	12			1.61	1.47	1.61	1.62	0.003	13.7	13.8	5.1	0.13				5.0
13-18	0.42	0.030	14			1.68	1.53	1.68	1.69	0.003	13.8	13.3	5.8	0.12				6.5
18-30	0.23			-(s)		1.72	1.53e	1.70e	1.72	0.003	10.1	12.5f	4.7	0.12g				7.3
30-37	0.13			-(s)		1.80	1.65e	1.79e	1.81	0.003	9.9	11.6f	3.7	0.13g				7.7
37-45	0.12			tr(s)	-	1.81	1.66e	1.79e	1.82	0.007	12.0	12.1f	3.2	0.15g		7.4		7.8
45-60	0.08			2	-	1.99	1.82e	1.98e	1.98	-	9.6	9.4f	3.3	0.11g				8.5
60-76	0.12			3	-	1.99	1.78e	1.96e	1.97	0.003	10.1	9.7f	3.6	0.11g				8.5

Depth (In.)	Extractable bases 5B1a: 6N2a Ca	6Q2a Mg	6P2a Na	6Q2a K	Sum	6H1a Ext. Acidity	Cat. Exch. Cap.: 5A3a Sum Cations	5A1a NH4OAc	6G1d KCl-Ext. Al	6C2a Ext. Iron as Fe Pct.	8E1 Resistivity ohms-cm.	8B1a Elec. Cond. mmhos/cm.	8B Water at Sat. Pct.	8D3 Ca/Mg	Base saturation: 5C3 Sum Cations Pct.	5C1 NH4OAc Pct.
	meq/100 g															
0-6	14.3	3.6	0.3	0.2	18.4	11.2	29.6	19.1		0.7				4.0	62	96
6-10	7.4	2.8	0.2	0.1	10.5	6.5	17.0	11.8	0.1	0.9				2.6	62	89
10-13	5.1	2.7	0.1	0.1	8.0	5.4	13.4	8.8	0.1	1.0				1.9	60	91
13-18	6.3	3.5	0.2	0.1	10.1	3.5	13.6	9.6		1.2				1.8	74	105
18-30	6.0	3.3	0.1	0.1	9.5	2.3	11.8	8.6		1.1				1.8	81	110
30-37	4.9h	2.7i	0.1	0.1	7.8	1.4	9.2	7.3		0.9				1.8	85	107
37-45	3.9h	1.6i	0.1	0.1	5.7			6.0		0.7	6700	0.30	19.8	2.4		
45-60	4.4h	1.4i	0.1	0.1	6.0			5.3		0.7				3.1		
60-76	4.3h	1.6i	0.1	0.1	6.1			5.0		0.6				2.7		

Depth (In.)	Ratios to Clay 8D1: NH4OAc CEC	Ext. Iron	15-Bar Water
0-6	1.48	0.05	0.79
6-10	1.04	0.08	0.53
10-13	0.78	0.09	0.45
13-18	0.74	0.09	0.45
18-30	0.86	0.11	0.47
30-37	0.91	0.11	0.46
37-45	0.92	0.11	0.49
45-60	0.75	0.10	0.46
60-76	0.60	0.07	0.43

a. Fe-Mn nodules: 25-35 percent (2-0.5 mm).
b. Carbonate grains: 1-5 percent (1-0.05 mm).
c. 13 kg/m^2 to 60 inches (Method 6A).
d. Calculated to include volume but not weight of 2- to 19-mm material (Method 3B2).
e. 1/10-bar (Method 4A1g).
f. 1/10-bar (Method 4B1c).
g. 1/10- to 15-bar (Method 4C2).
h. NH_4Cl-EtOH extract (Method 6N3a).
i. NH_4Cl-EtOH extract (Method 6O3a).

Soil classification: Aquic Fragiboralf; coarse-loamy, mixed.
Soil: Mora Series.
Soil S63MN-5-1.
Area: Benton County, Minnesota.
Location: SE¼ SW¼ SW¼ Sec. 13, T37N, R29W, 300 feet north of road and 900 feet east of fence between pasture and cropland.
Vegetation: Pasture - bluegrass and redtop with scattered oak and elm.
Parent material: Red till - sandy loam.
Physiography: Ground moraine
Slope: 1 percent.
Aspect: South.
Erosion: None.
Drainage: Somewhat poor.
Permeability: Moderately slow.
Ground water: 48 inches.
Moisture: Very moist.
Stoniness: Stony.
Roots: Common to 6 feet with no apparent restriction
Sampled September 30, 1963, by W. W. Anderson, M. F. Grimes, R. Farnham, M. Ziebell, G. Holmgren, and R. L. Juve.
Described by: W. W. Anderson.

Horizon	
Ap LSL 18848	0 to 6 inches, very dark gray (10YR 3/1) to black (10YR 2/1) fine sandy loam to loam with few medium distinct dark reddish brown (5YR 3/2) mottles; cloddy; friable; pH 5.8; abrupt wavy boundary.
A21g LSL 18849	6 to 10 inches, dark gray (10YR 4/1) to very dark gray (10YR 3/1) fine sandy loam to sandy loam with common fine distinct dark brown (10YR 4/3) and common fine faint dark grayish brown (10YR 4/2) and very dark grayish brown (10YR 3/2) mottles; moderate to weak thin platy structure; very friable; many bleached sand grains; pH 5.4; gradual wavy boundary.
A22g LSL 18850	10 to 13 inches, gray (10YR 5/1) to dark gray (10YR 4/1) fine sandy loam with common fine distinct dark brown (7.5YR 4/4) and common fine faint dark gray (5YR 4/1) mottles; weak medium platy structure; more bleached sand grains than above; pH 5.4; clear smooth boundary.
A&B LSL 18851	13 to 18 inches, dark gray (10YR 4/1) and brown (7.5YR 4/4) heavy loam; A2 material is dark gray (10YR 4/1) with moderate thin and medium platy structure; remnants of the B are brown (7.5YR 4/4) with weak medium subangular blocky structure; friable; common fine distinct dark brown (10YR 4/3) and dark grayish brown (10YR 4/2) mottles; vesicular; pH 5.4; gradual wavy boundary.
B2 LSL 18852	18 to 30 inches, mottled dark brown (7.5YR 3/4), reddish brown (5YR 4/4) and [illegible] loam; weak thick platy structure; friable; moderate clay films in patches on upper side of plates; pH 6.6; gradual wavy boundary.
Bx1 LSL 18853	30 to 37 inches, reddish brown (5YR 4/3) sandy loam to sandy clay loam with many medium faint dark brown to brown (7.5YR 4/4) and reddish brown (5YR 4/4) mottles; weak thick platy structure; friable, firm in place; common thick patchy clay films on top of plates with thick clay films in small root channels; pH 6.8; gradual wavy boundary.
Bx2 LSL 18854	37 to 45 inches, reddish brown (5YR 4/3) sandy loam with few fine faint reddish brown (5YR 4/4) and reddish gray (5YR 5/2) mottles; strong thin platy structure; friable, firm in place; few thin patchy clay films on surface of plates; pH 6.8; clear smooth boundary.
C1x LSL 18855	45 to 60 inches, reddish brown (5YR 4/3) sandy loam; strong thin platy structure; friable, firm in place; effervesces with acid; gradual smooth boundary.
C2x	60 to 76 inches, reddish brown (5YR 4/3) [illegible]

SOIL CLASSIFICATION: Aquic Fragiboralf; coarse-loamy, mixed

U. S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL Mora Series SOIL Nos. S63 MN-5-2 LOCATION Benton County, Minnesota

SOIL SURVEY LABORATORY Lincoln, Nebraska LAB. Nos. 18897-18905 August 1967

General Methods: 1A, 1B1b, 2A1, 2B

Depth (In.)	Horizon	Size class and particle diameter (mm) 3A1 — Total: Sand (2–0.05)	Total: Silt (0.05–0.002)	Total: Clay (< 0.002)	Sand: Very coarse (2–1)	Sand: Coarse (1–0.5)	Sand: Medium (0.5–0.25)	Sand: Fine (0.25–0.1)	Sand: Very fine (0.1–0.05)	Silt: 0.05–0.02	Silt: Int. III (0.02–0.002)	Int. II (0.2–0.02)	(2–0.1)	Coarse fragments 2A2: 3B1 2-19 Wt. Pct.	Coarse fragments 2A2: 3B2 2-19 Vol. Pct.
		Pct. of < 2 mm													
0-4	Ap	48.6	40.0	11.4	1.0	6.6	11.6	19.4	10.0	18.1	21.9	37.7	38.6	1	
4-7	A21	53.6	39.2	7.2	2.2	7.4	11.7	20.8	11.5	18.8	20.4	40.7	42.1	1	
7-12	A22	53.8	37.4	8.8	3.6	7.0	10.7	21.0	11.5	17.9	19.5	40.0	42.3	6	4
12-17	B1	55.6	31.3	13.1	4.3	6.5	10.4	22.0	12.4	16.1	15.2	39.9	43.2	13	8
17-24	B21	59.8	28.3	11.9	4.5	7.9	12.2	23.1	12.1	14.6	13.7	38.5	47.7	14	9
24-31	B22	60.2	29.0	10.8	4.9	9.2	12.5	21.7	11.9	14.2	14.8	37.0	48.3	12	8
31-48	C1x	65.0	30.4	4.6	3.6	8.7	13.8	25.6	13.3	14.4	16.0	40.9	51.7	11	8
48-75	C2x	66.9	27.6	5.5	4.6	9.3	14.2	25.7	13.1	14.4	13.2	40.7	53.8	10	7
75-99	C3x	58.3	33.7	8.0	3.6	8.2	12.0	22.5	12.0	15.7	18.0	39.3	46.3	10	

Depth (In.)	6A1a Organic carbon	6B1a Nitrogen	C/N	Carbonate as $CaCO_3$: 6E1b	3A1a <0.002	Bulk density: 4A1a Field-State	4A1d 1/3-Bar	4A1d 1/3-Bar	4A1b Air-Dry	4I1 COLE	Water content: 4B4 Field-State	4B1c 1/3-Bar	4B2 15-Bar	4C1 1/3-to 15-Bar	pH: 8C1b Sat. Paste		8C1a (1:1)

Soil classification: Aquic Fragiboralf; coarse-loamy, mixed.
Soil: Mora series.
Soil Nos.: S63 MN-5-2.
Area: Benton County, Minnesota.
Location: SW¼ SW¼ SW¼ Sec. 13, T37N, R29W, 300 feet north of east-west road, 40 feet east of fence line.
Vegetation: Bluegrass pasture.
Parent material: Red till - sandy loam.
Physiography: Very gently undulating till plain.
Slope: 1 to 2 percent.
Aspect: South.
Erosion: None.
Drainage: Moderately well.
Permeability: Moderate.
Ground water: Deep.
Moisture: Moist.
Root distribution: Common to 36 inches, very few below.
Stoniness: Common in pit.
Sampled September 30, 1963, by W. W. Anderson, M. F. Grimes, R. Farnham, M. Ziebell, G. Holmgren and R. L. Juve.
Described by: W. W. Anderson.

Horizon

Ap LSL 18897	0 to 4 inches, black (10YR 2/1) to very dark gray (10YR 3/1) loam; moderate medium granular structure; very friable; a few brown (10YR 5/3) wormcasts; abrupt smooth boundary.
A21 LSL 18898	4 to 7 inches, dark grayish brown (10YR 4/2) with some dark gray (10YR 4/1) fine sandy loam with common fine distinct dark yellowish brown (10YR 4/4) and common fine faint dark brown (10YR 4/3) mottles; weak to moderate medium and thin platy structure; very friable; clear smooth boundary.
A22 LSL 18899	7 to 12 inches, brown (10YR 5/3) fine sandy loam with common fine faint yellowish brown (10YR 5/4) and dark brown (10YR 4/3) mottles; weak to moderate medium and thin platy structure; friable; clear smooth boundary.
B1 LSL 18900	12 to 17 inches, dark brown (7.5YR 4/4) to reddish brown (5YR 4/4) loam with common fine faint brown (7.5YR 5/2-5/4) and reddish brown (5YR 4/3) mottles; weak medium and fine subangular blocky structure; friable; clear wavy boundary.
B21 LSL 18901	17 to 24 inches, variegated reddish brown (5YR 4/3 and 4/4) and 10 percent reddish gray (5YR 5/2) sandy clay loam with few fine faint dark reddish brown (5YR 3/4) mottles; weak medium and thin platy structure; friable; gradual wavy boundary.
B22 LSL 18902	24 to 31 inches, variegated reddish brown (5YR 4/3 and 5/3) sandy clay loam with few fine faint yellowish red (5YR 4/6) mottles; weak medium and thick platy structure; friable; few thin patchy clay films on top surface of plates and in some pores; clear irregular boundary.
C1x LSL 18903	31 to 48 inches, dark reddish brown (5YR 3/3) and reddish brown (5YR 4/3) sandy loam with few coarse distinct reddish brown (5YR 5/3) mottles; strong thin and medium platy structure; friable to firm, very brittle; diffuse boundary.
C2x LSL 18904	48 to 75 inches, dark reddish brown (5YR 3/4) and reddish brown (5YR 4/3) sandy loam; moderate thin and medium platy structure; firm, and brittle; abrupt smooth boundary.
C3 LSL 18905	75 to 99 inches, reddish brown (5YR 4/3) sandy loam; strong medium platy breaking to fine angular blocky structure; firm, and brittle; slight effervescence with acid. Sampled at 75- to 82-inch depth.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL Mora taxadjunct SOIL Nos. S63MN-5-4 LOCATION Benton County, Minnesota

SOIL SURVEY LABORATORY Lincoln, Nebraska LAB. Nos. 18906-18915 August 1967

General Methods: 1A, 1B1b, 2A1, 2B

Depth (In.)	Horizon	Size class and particle diameter (mm) 3A1 — Total: Sand (2–0.05) 3a	Total: Silt (0.05–0.002)	Total: Clay (< 0.002)	Sand: Very coarse (2–1)	Sand: Coarse (1–0.5)	Sand: Medium (0.5–0.25)	Sand: Fine (0.25–0.1)	Sand: Very fine (0.1–0.05)	Silt: 0.05–0.02	Silt: Int. III (0.02–0.002)	Int. II (0.2–0.02)	(2–0.1)	Coarse fragments 2A2: 3B1 2-19 Wt. Pct.	Coarse fragments 2A2: 3B2 2-19 Vol. Pct.
		Pct of < 2 mm													
0-2	Ap	44.7	42.4	12.9	0.8	6.2	10.5	18.4	8.8	17.8	24.6	35.6	35.9	-	
2-4	A21	50.6	40.1	9.3	1.6	7.0	12.0	20.4	9.6	16.9	23.2	36.7	41.0	1	1
4-10	A22	53.7	40.7	5.6	3.0	7.4	11.3	21.1	10.9	18.4	22.3	40.2	42.8	6	4
10-14	A23	54.2	39.0	6.8	4.0	7.3	10.8	20.8	11.3	17.7	21.3	39.8	42.9	9	6
14-23	B21	57.5	33.5	9.0	3.2	7.2	11.3	22.5	13.3	15.2	18.3	40.1	44.2	11	7
23-32	Bx1	56.2	28.1	15.7	3.1	8.0	11.9	21.4	11.8	12.8	15.3	35.4	44.4	12	9
32-39	Bx2	56.7	30.8	12.5	3.0	7.9	11.5	21.8	12.5	14.2	16.6	37.9	44.2	12	9
39-49	C1x	57.1	31.7	11.2	4.3	7.9	11.1	21.6	12.2	14.2	17.5	37.6	44.9	14	10
49-58	C2x	57.2	31.9	10.9	3.4	7.8	11.3	22.3	12.4	14.1	17.8	38.0	44.8	12	9
58-65+	C3x	56.9	33.1	10.0	3.8	7.8	11.1	21.8	12.4	14.6	18.5	38.2	44.5	13	10

Depth (In.)	Organic carbon 6A1a b Pct	Nitrogen 6B1a Pct	C/N	Carbonate as $CaCO_3$: 6B1b 6E2a < 2mm. Pct.	Carbonate as $CaCO_3$: 3A1a <0.002 mm. Pct.	Bulk density: 4A1a Field-State g/cc	Bulk density: 4A1d 1/3-Bar c g/cc	Bulk density: 4A1d 1/3-Bar g/cc	Bulk density: 4A1b Air-Dry g/cc	4H1 COLE	Water content: 4B4 Field-State Pct	Water content: 4B1c 1/3-Bar Pct.	Water content: 4B2 15-Bar Pct	Water content: 4C1 1/3-to 15-Bar In./in.	pH 8C1a (1:1)
0-2	3.91	0.284	14			1.25		1.28	1.29	-	27.5	26.5	10.1	0.21	5.5
2-4	1.21	0.097	12			1.68	1.66	1.68	1.67	-	14.7	14.5	5.4	0.15	5.6
4-10	0.23	0.020				1.77	1.69d	1.76d	1.75	-	11.2	13.3e	2.7	0.18f	5.6
10-14	0.16					1.78	1.66d	1.77d	1.77	-	11.7	13.7e	3.3	0.17f	5.7
14-23	0.12					1.72	1.59d	1.71d	1.71	-	12.4	14.1e	4.6	0.15f	6.0
23-32	0.09			-(a)		1.86	1.66	1.82	1.86	0.006	11.3	12.0	7.2	0.08	7.3
32-39	0.05			1	-	1.86	1.67	1.83	1.87	0.006	11.7	12.2	6.2	0.10	8.0
39-49	0.02			1	-	1.90	1.68	1.87	1.91	0.006	11.0	11.4	5.1	0.11	8.1
49-58	0.02			1	-	1.95	1.74d	1.91d	1.95	0.006	10.1	11.9e	4.5	0.13f	8.2
58-65+	0.02			1	-	1.98	1.78d	1.98d	1.97	-	8.9	10.9e	3.9	0.13f	8.5

Depth (In.)	Extractable bases 6N2a Ca	6O2a Mg	6P2a Na	6Q2a K	5H1a Sum	6H1a Ext. Acidity	Cat. Exch. Cap. 5A3a Sum Cations	5A1a NH_4OAc	8D3 Ca/Mg	Base saturation 5C3 Sum Cations	Base saturation 5C1 NH_4OAc
	meq/100 g									Pct	Pct
0-2	10.8	1.9	0.1	0.2	13.0	12.8	25.8	19.4	5.7	50	67
2-4	4.8	0.7	0.1	0.1	5.7	7.5	13.2	9.6		43	59
4-10	1.6	0.6	tr	tr	2.2	3.7	5.9	4.2		37	52
10-14	2.2	1.1	0.1	0.1	3.5	3.5	7.0	5.1	2.0	50	69
14-23	3.4	2.6	0.1	0.1	6.2	3.7	9.9	7.1	1.3	63	87
23-32	7.2	6.2	0.2	0.2	13.8	2.4	16.2	13.0	1.2	85	106
32-39	6.7g	4.3h	0.2	0.2	11.4			11.2	1.6		
39-49	5.7g	3.2h	0.1	0.1	9.1			9.0	1.8		
49-58	5.4g	2.7h	0.1	0.1	8.3			8.0	2.0		
58-65+	5.5g	2.0h	0.1	0.1	7.7			6.9	2.8		

Depth (In.)	Ratios to Clay 8H1 NH_4OAc CEC	15-Bar Water
0-2	1.50	0.78
2-4	1.03	0.58
4-10	0.75	0.48
10-14	0.75	0.49
14-23	0.79	0.51
23-32	0.83	0.46
32-39	0.90	0.50
39-49	0.80	0.46
49-58	0.73	0.41
58-65+	0.69	0.39

a. Trace of carbonate in sands below 32 inches.
b. 5.5 kg/m^2 to 60 inches (Method 6A).
c. Calculated to include volume but not weight of 2- to 19-mm material (Method 3B2).
d. 1/10-bar (Method 4A1g).
e. 1/10-bar (Method 4B1c).
f. 1/10- to 15-bar (Method 4C2).
g. NH_4Cl-EtOH extraction (Method 6N3a).
h. NH_4Cl-EtOH extraction (Method 6O3a).

Pedon classification: Typic Fragiboralf; coarse-loamy, mixed.
Series classification: Aquic Fragiboralfs; coarse-loamy, mixed.
Soil: Mora Taxadjunct.
Soil Nos.: S63MN-5-4.
Area: Benton County, Minnesota.
Location: NW¼ NW¼ NE¼ Sec. 23, T38N, R29W, 225 feet south of road fence 25 feet west of two white pine.
Vegetation: Pastured woods (white oak, red oak, hard maple, ash, white pine, birch)
Parent material: Red till - sandy loam.
Physiography: Gently sloping ground moraine.
Slope: 2 percent.
Aspect: South.
Erosion: None.
Drainage: Moderately well.
Permeability: Moderate.
Moisture: Moist.
Stoniness: Few. Described by: W. W. Anderson.
Sampled October 1, 1963, by W. W. Anderson, M. F. Grimes, R. Farnham, M. Ziebell, G. Holmgren, and R. L. Juve.

Horizon	
Ap LSL 18906	0 to 2 inches, black (10YR 2/1) to very dark brown (10YR 2/2) and 30% dark brown (7.5YR 4/2) fine sandy loam to loam; weak medium granular structure; friable; abundant earthworms; pH 6.2; abrupt wavy boundary.
A21 LSL 18907	2 to 4 inches, very dark brown (10YR 2/2) to very dark grayish brown (10YR 3/2) fine sandy loam; weak thin platy structure; friable; (tongue 1 to 2 inches wide extending to 13-inch depth); clear wavy boundary.
A22 LSL 18908	4 to 10 inches, brown (10YR 5/3 and 7.5YR 5/4) fine sandy loam with few fine faint dark brown (7.5YR 4/4) mottles (2 percent); weak to moderate thin platy structure; very friable; earthworm holes filled with material from above; pH 5.4; clear irregular boundary.
A23 LSL 18909	10 to 14 inches, dark grayish brown (10YR 4/2) to brown (10YR 4/3) with spots of dark brown (7.5YR 4/4) (these are remnants of B) fine sandy loam with common medium faint dark brown (7.5YR 4/4) and reddish brown (5YR 4/4) mottles; weak to moderate medium platy structure; very friable; (some remnants of B included but not enough to call A and B); vesicular; pH 5.4; clear wavy boundary.
B21 LSL 18910	14 to 23 inches, reddish brown (5YR 4/3) sandy loam (more clay than above), with many fine distinct reddish brown (5YR 5/3), dark reddish brown (5YR 3/4) and yellowish red (5YR 4/6) mottles; weak medium subangular blocky structure; friable; few thin patchy clay films; pH 5.4; clear wavy boundary. This horizon was saturated.
Bx1 LSL 18911	23 to 32 inches, reddish brown (5YR 4/3 to 2.5YR 4/4) sandy clay loam with many medium distinct yellowish red (5YR 4/6) and reddish brown (5YR 4/4) mottles; weak medium platy breaking readily to weak fine subangular blocky structure; friable, firm in place; thick nearly continuous clay skins on top of plates; thick clay films in pebble sockets; pH 6.4; clear wavy boundary.
Bx2 LSL 18912	32 to 39 inches, reddish brown (5YR 4/3 to 2.5YR 4/4) and dark reddish brown (5YR 3/3) sandy loam to sandy clay loam; exterior ped dark reddish brown (5YR 3/3), interior ped reddish brown (5YR 4/3 to 2.5YR 4/4) with few fine faint 5 percent yellowish red (5YR 4/6) and reddish brown (5YR 4/4) mottles; weak to moderate medium platy structure breaks to weak fine subangular blocky structure; friable, firm in place; some very small dark colored concretions; plate surfaces appear to have thin patchy clay coatings; some vesicules 1 mm in diameter also appear to have 5YR 3/3 coatings; pH 6.8; clear wavy boundary.
C1x LSL 18913	39 to 49 inches, dark reddish brown (5YR 3/4) sandy clay loam; moderate medium thin platy structure; firm, very firm in place; effervesces in spots with acid.
C2x LSL 18914	49 to 58 inches, dark reddish brown (5YR 3/4) sandy clay loam; moderate medium to thin platy structure; firm to very firm in place; effervesces in spots with acid.
C3x LSL 18915	58 to 65 inches +, reddish brown (2.5YR 4/4) sandy loam; weak to moderate medium thin platy structure; firm to very firm in place; effervesces with acid.

SOIL CLASSIFICATION- TYPIC FRAGIBORALF
COARSE-LOAMY, MIXED
SERIES - - - - - - - MORA TAXADJUNCT

SOIL NO - - - - - - S68MN-9-1 COUNTY - - - CARLTON

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 68L1202-68L1210

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, MTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

FEBRUARY 1977

DEPTH CM	HORIZON	SAND 2-.05	SILT .05-.002	CLAY LT .002	FINE CLAY LT .0002	VCOS 2-1	CORS 1-.5	MEDS .5-.25	FNES .25-.10	VFNS .10-.05	COSI .05-.02	FNSI .02-.002	VFSI .005-.002	FAML TEXT SAND 2-.1	INTR II .2-.02	FINE CLAY TO CLAY PCT	NON-CO3-CLAY PCT	RATIO 8D1 15-BAR TO CLAY
		(- - PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B - - PCT LT 2MM - -)																
000-10	A1	26.1	61.4	12.5		1.3	2.0	3.7	9.9	9.3	26.5	34.9		16.8	41.5			1.22
010-18	A21G	47.6	46.0	6.4		2.0	5.5	11.1	18.7	10.2	27.6	18.4		37.3	46.6			.63
018-28	A22	43.9	47.8	8.3		1.6	5.2	10.0	17.3	9.8	27.6	20.2	4.1	34.1	45.7			.55
028-53	B2t	54.6	32.3	13.1		3.8	8.0	11.3	19.7	11.8	17.0	15.3		42.8	38.8			.60
053-76	Bx1	55.5	32.6	11.9		3.5	8.0	11.0	19.3	13.7	17.6	15.0	4.2	41.8	41.3			.59
076-109	Bx2	52.3	37.5	10.2		3.2	6.3	9.4	18.4	15.0	21.1	16.4		37.3	46.1			.57
109-147	Bx3	54.6	34.5	10.9		3.2	7.0	10.5	22.1	11.8	15.0	19.5		42.8	38.5			.50
147-185	C	54.6	37.8	7.6		4.8	6.9	9.9	20.2	12.8	17.7	20.0	5.4	41.8	41.3			.51
185-216	C	54.7	38.9	6.4		4.3	6.7	8.8	21.7	13.1	19.6	19.3		41.6	44.4			.56

DEPTH CM	VOL. GT 2 PCT	WEIGHT GT 75 PCT	75-20 PCT LT 75	20-5 PCT LT 75	5-2 PCT LT 75	LT .074 PCT LT 75	20-2 PCT LT20	4A1D 1/3-BAR G/CC	4A1H OVEN DRY G/CC	4D1 COLE	4B1C 1/10 BAR PCT	4B1C 1/3-BAR PCT	4B2 15-BAR PCT	4C1 WRD CM/CM	CARBONATE 6E1B LT 2 PCT	3A1A LT .002 PCT	PH 8C1A 1/1 H2O	PH 8C1E 1/2 CACL
	(PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2)							(BULK DENSITY)			(- - -WATER CONTENT- - -)							
000-10	TR	0	TR	2	TR	78	2	.93	1.03	.035		54.7	15.3	.37			3.9	3.4
010-18	3	0	TR	3	2	56	5	1.73	1.77	.008	16.6		4.0	.22			4.8	4.0
018-28	2	0	TR	2	2	60	4	1.70A					4.6				5.3	4.3
028-53	5	0	TR	5	4	47	9	1.65	1.69	.008		16.3	7.8	.13			5.3	4.5
053-76	7	0	TR	7	4	47	11	1.65	1.70	.009		15.8	7.0	.13			5.4	4.5
076-109	7	0	TR	7	4	50	11	1.70	1.76	.011		14.4	5.8	.13			5.6	4.8
109-147	7	0	TR	7	4	46	11	1.75	1.82	.012		13.5	5.4	.13			5.9	5.1
147-185	8	0	TR	6	5	46	11	1.88	1.92	.006	11.6		3.9	.13			6.2	5.3
185-216		0	TR	8	6	45	14						3.6				6.4	5.5

DEPTH CM	ORGANIC MATTER 6A1A ORGN CARB PCT	6B1A NITG PCT	C/N	IRON 6C2A EXT FE PCT	PHOS 6S1A TOTL UG/G	6N2E CA	6O2D MG	6P2A NA	6Q2A K	SUM EXTB	ACTY 6H1A BACL TEA	AL 6G1C KCL EXT	(CAT EXCH) 5A3A EXTB ACTY	5A6A NHAC	RATIO 8D1 NHAC TO CLAY	RATIO 8D3 CA TO MG	CA 5F SAT NHAC PCT	(BASE SAT) 5C3 EXTB ACTY PCT	5C1 NHAC PCT
						(- -EXTRACTABLE BASES 5B4A- -) MEQ / 100 G													
000-10	9.74B	.603	16	.3	9200	4.0	1.1	.1	.3	5.5	38.4	4.3	43.9	30.2	2.42	3.6	13	13	18
010-18	1.02	.066	15	.7	3400	.8	.2	.1	TR	1.1	9.0	2.2	10.1	6.8	1.06	4.0	12	11	16
018-28	.13	.014		1.5	1450	1.8	.9	.1	TR	2.8	5.2	.7	8.0	5.4	.65	2.0	33	35	52
028-53	.13			2.4	870	5.2	2.9	.1	.1	8.3	7.3	.5	15.6	11.4	.87	1.8	46	53	73
053-76	.15			2.1	1750	5.3	3.0	.1	.1	8.5	6.4	.7	14.9	11.3	.95	1.8	47	57	75
076-109	.05			1.7	1800	6.0	3.2	.1	.2	9.5	4.7		14.2	11.0	1.08	1.9	55	67	86
109-147	.02			1.6	1550	6.8	3.2	.1	.1	10.2	3.2		13.4	10.9	1.00	2.1	62	76	94
147-185	.02			1.3	1650	5.1	2.6	.1	.1	7.9	2.3		10.2	8.2	1.08	2.0	62	77	96
185-216	.05			1.3	1650	4.8	2.5	.1	.1	7.5	1.7		9.2	7.8	1.22	1.9	62	82	96

DEPTH CM	(SATURATED PASTE) 8E1 REST OHM-CM	8C1B PH	8A H2O PCT	NA 5D2 ESP PCT	NA 5E SAR	SALT 8D5 TOTL SOLU PPM	GYP 6F1A PCT	8A1A EC MMHOS/CM	6N1B CA	6O1B MG	6P1A NA	6Q1A K	6I1A CO3	6J1A HCO3	6K1A CL	6L1A SO4	6M1A NO3	ATTERBERG 4F1 LQID LMIT PCT	4F2 PLST INDX
									(- - SATURATION EXTRACT 8A1- - MEQ / LITER - -)										
000-10																			
010-18																			
018-28																			
028-53																			
053-76																			
076-109	7400	5.1	16.5			20		.16											
109-147																			
147-185																			
185-216																			

IDENTIFICATION OF SPODIC HORIZON BY LABORATORY CRITERIA (D).

DEPTH	HORIZON	(PYROPHOSPHATE,PH10) 6C5A EXT FE PCT	6G5A EXT AL PCT	6A1B EXT C PCT	(CIT - DIT) 6C2A EXT FE PCT	(PYROPHOSP) 6G7A EXT AL PCT	FE+AL / CLAY	AL+C / CLAY	PYRO FE+AL / C - D FE+AL	CEC -1/2 CLAY X THIC
053-76	B21TX	.1	TR		2.1					206

(A) ESTIMATED.
(B) ORGANIC CARBON IS 12 KG/M SQ TO A DEPTH OF 1 M (6A).
(C) UG/G - PERCHLORIC ACID DIGESTION, AMMONIUM MOLYBDATE AND STANNOUS CHLORIDE ACID COLORIMETRY. ANALYSIS BY M. SINGER INSTITUTE OF AGRICULTURE, UNIVERSITY OF MINNESOTA, ST. PAUL, MINNESOTA.
(D) SOIL SURVEY INVESTIGATIONS UNIT, BELTSVILLE, MARYLAND.

Pedon classification: Typic Fragiboralf; coarse-loamy, mixed.
Series classification: Aquic Fragiboralfs; coarse-loamy, mixed.
Soil: Mora taxadjunct*.
Soil No.: S68MN-9-1.
Location: Carlton County, Minnesota; NW¼, NE¼, SW¼, Sec. 34, T. 49 N., R. 20 W.; 1,050 feet west and 60 feet south of the center of the section. About 92 deg., 52 min. west longitude and 46 deg., 41 min. north latitude.
Climate: Humid continental. Some characteristics of temperature in deg. F. are: annual normal - 40, winter normal - 12, summer normal - 65; some characteristics of precipitation in inches are: mean annual - 28, May to September - 19, mean snowfall - 55.
Parent material: Reddish brown coarse-loamy glacial till of Automba phase of the Superior Lobe of the Late Wisconsin glaciation.
Physiography: Central lowlands; Brainerd-Automba Drumlin Area (H. E. Wright, 1972); Drumlin field with local relief of mostly 20 to 30 feet.
Landscape setting: Site has a ½ percent concave slope. Local relief in the vicinity of the site is about 10 feet and this pedon is on the lower part of the terrain. Elevation is about 1,310 feet. Soils of the Ahmeek series, this series, and organic soils are dominant in the immediate vicinity.
Vegetation: Plant community of deciduous-coniferous forest with mostly aspen, maples, elm and an understory of hazel, alder, raspberry, and sedges.
Drainage: Somewhat poorly or poorly drained.
Erosion: None.
Moisture: Moist throughout.

Permeability: Moderate in upper part and moderately slow in lower part.
Described by: R. R. Lewis and H. R. Finney on October 7, 1968.
Sampled by: L. Shields, G. Holmgren, R. Rust, P. Nyberg on October 7, 1968.

A1 68L1202 0 to 10 cm (0 to 4 inches) Black (10YR 2/1) silt loam; moderate fine and very fine granular structure grading to weak fine and very fine granular structure in the lower part; very friable; about 25 percent roots, mostly 1 mm and ranging from 0.5 to 25 mm; about 1 percent coarse fragments mostly 2 to 5 mm; horizon ranges from 2.5 to 12 inches in thickness; thicker parts occupy widths of 1 to 2 feet; mostly clear wavy boundary, but in places irregular.

A21g 68L1203 10 to 18 cm (4 to 7 inches) Grayish brown (2.5Y 5/2) fine sandy loam; common fine distinct brown (2.5Y 5/4) mottles; moderate medium platy structure parting to weak very fine subangular blocky structure; very friable; abundant very fine and fine exped open vesicular pores mostly on upper surface of plates and a few very fine continuous vertical inped simple tubular pores; few random very fine and fine roots; about 1 percent coarse fragments, mostly 2 to 5 mm; horizon mostly ranges from 2 to 4 inches in thickness, but in places is absent; clear wavy boundary.

A22 68L1204 18 to 28 cm (7 to 11 inches) Yellowish brown (10YR 5/4) fine sandy loam; many medium distinct strong brown (7.5YR 5/6) mottles; weak medium and coarse platy structure; very friable; abundant very fine and fine exped open vesicular pores mostly on upper surface of plates and a few very fine continuous vertical inped simple tubular pores; few random very fine and fine roots; about 5 percent coarse fragments, mostly 2 to 5 mm; about 1 to 2 percent soft dark reddish brown masses; horizon mostly ranges from 2 to 6 inches in thickness, but in a few places is absent; abrupt wavy boundary.

B2t 68L1205 28 to 53 cm (11 to 21 inches) Reddish brown (5YR 4/3) sandy loam; many fine faint reddish brown (5YR 4/4) dark reddish brown (5YR 3/4) and yellowish red (5YR 4/6) mottles; moderate medium platy structure; friable; very few fine and very fine roots; very few very fine discontinuous vertical inped simple tubular pores; very few thin clay films on upper plate surfaces; more sand grains and coarse fragments on lower plate surfaces than upper surfaces; about 0.5 percent soft dark reddish brown masses; about 5 percent coarse fragments; very few reddish gray (5YR 4/2) coatings on vertical cleavage faces; gradual wavy boundary.

Bx1 68L1206 53 to 76 cm (21 to 30 inches) Reddish brown (5YR 4/3) sandy loam; common fine faint dark reddish brown (5YR 3/4) reddish brown (5YR 4/4) and dark red (2.5YR 3/6) mottles; moderate medium platy structure parting to weak very thin platy structure; firm; ruptures abruptly under slight pressure; very few very fine and fine roots; few micro discontinuous random inped simple tubular pores; few thin clay films on upper plate surfaces; about 5 percent coarse fragments mostly 2 to 10 mm; gradual wavy boundary.

Bx2 68L1207 76 to 109 cm (30 to 43 inches) Dark reddish brown (5YR 3/3) sandy loam; few fine faint yellowish red (5YR 4/6) and dark red (2.5YR 3/6) mottles; strong medium platy structure parting to moderate very thin platy structure; firm; ruptures abruptly under medium pressure; very few micro and very fine roots; very few micro discontinuous random inped simple tubular pores; common thin clay films on upper plate surfaces and few thin clay films with many exposed sand grains on lower plate surfaces; about 0.5 percent of pit face has reddish brown (5YR 5/3) loamy sand horizontal and vertical streaks up to 4 cm in width; about 5 percent coarse fragments; diffuse smooth boundary.

Bx3 68L1208 109 to 147 cm (43 to 58 inches) Dark reddish brown (5YR 3/4) sandy loam; moderate medium and coarse platy structure parting to weak thin platy structure; firm; ruptures abruptly under slight pressure; few discontinuous clay films on upper plate surfaces; very few thin black 0.5 to 1.0 mm circular shaped (MnO_2?) coatings; about 5 percent coarse fragments; few discontinuous (medium) sand lenses up to 2 inches thick occupying about 10 percent of pit face mostly in one part; diffuse smooth boundary.

C 68L1209 147 to 185 cm (58 to 73 inches) 68L1210 185 to 216 cm.(73 to 85 inches). Dark reddish brown (5YR 3/4) sandy loam; moderate medium and coarse platy structure parting to weak [illegible]

SOIL CLASSIFICATION-TYPIC UDIPSAMMENT
MIXED, FRIGID
[redacted]

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, MTSC
[redacted]
LINCOLN, NEBRASKA

SOIL NO - - - - - - S68MN-9-5 COUNTY - - - CARLTON

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 68L1152-68L1161 FEBRUARY 1977

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B														RATIO
					FINE	SAND					SILT			FAML	INTR	FINE	NON-	8D1
		SAND	SILT	CLAY	CLAY	VCOS	CORS	MEDS	FNES	VFNS	COSI	FNSI	VFSI	TEXT	II	CLAY	CO3-	15-
		2-	.05-	LT	LT	2-	1-	.5-	.25-	.10-	.05	.02	.005-	SAND	.2-	TO	CLAY	BAR
		.05	.002	.002	.0002	1	.5	.25	.10	.05	.02	.002	.002	2-.1	.02	CLAY		TC
CM		PCT LT 2MM														PCT	PCT	CLAY
000-5	A1	76.2	18.7	5.1		1.0	4.0	22.6	40.5	8.2	10.0	8.7		68.0	32.4			1.49
005-18	B21HIR	81.1	14.2	4.7		2.5	2.9	18.8	45.8	11.1	8.2	6.0		70.0	36.0			.72
018-30	B22HIR	85.9	11.1	3.0		2.2	3.4	25.9	46.4	8.0	7.4	3.7		77.9	30.0			.87
030-48	B23HIR	83.7	13.6	2.7		1.4	2.6	19.2	47.3	13.2	9.5	4.1		70.5	41.2			.74
048-69	B31	84.1	13.0	2.9		1.3	4.0	20.1	48.4	10.3	9.0	4.0		73.8	37.7			.59
069-104	B32	90.9	7.2	1.9		.9	3.5	24.0	53.5	8.5	5.4	1.8		82.0	32.1			.68
104-203	C	99.4	.6	TR		3.6	36.6	46.7	12.0	.5	.6	TR		98.9	3.0			
005-8	A2 (A)	77.8	17.5	4.7		2.0	4.8	22.7	41.1	7.1	9.2	8.3		70.6	30.1			.79
000-15	(B)	77.9	17.6	4.5		1.2	4.3	22.1	43.9	6.4	9.4	8.2		71.5	30.0			.87
015-30	(B)	76.9	18.3	4.8		1.0	3.7	20.6	44.9	6.7	11.1	7.2		70.2	32.3			.73

DEPTH	(PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2)(					BULK DENSITY		)(- - - -WATER		CONTENT- - - -)		CARBONATE	(- -PH - -)	
	VOL. (- - - - - - - WEIGHT - - - - - - -)					4A1D	4A1H	4D1	4B1C	4B1C	4B2	4C1		6E1B	3A1A	8C1A	8C1E
	GT	GT	75-20	20-5	5-2	LT	20-2	1/3-	OVEN	COLE	1/1C	1/3-	15-	WRD		LT	LT	1/1	1/2
	2	75				.074	PCT	BAR	DRY		BAR	BAR	BAR	CM/		2	.002	H2O	CACL
CM	PCT	PCT	(- - - PCT LT 75 - - -)			LT20	G/CC	G/CC			PCT	PCT	PCT	CM		PCT	PCT		
000-5		C	0	C	TR	27	TR				29.5C		7.6		36.3			4.5	4.2
005-18		C	0	1	4	23	5				12.7C		3.4		17.3			5.1	4.3
018-30		C	0	1	4	17	5				8.7C		2.6		11.4			5.4	4.5
030-48		0	0	3	4	21	7				8.5C		2.0		10.3			5.5	4.5
048-69		0	0	TR	2	20	2				8.0C		1.7		9.6			5.6	4.5
069-104		0	0	1	2	12	3				6.0C		1.3		8.9			5.8	4.6
104-203		0	0	TR	TR	1	TR				1.9C		.4		2.0			6.0	4.8
005-8		0	0	1	3	24	4				18.9C		3.7		22.1			4.7	4.2
000-15		C	0	TR	TR	25	TR				17.6C		3.9		22.5			6.5	5.7
015-30		C	0	TR	2	25	2				13.6C		3.5		15.0			6.7	5.6

DEPTH	(ORGANIC MATTER)			IRON	PHOS	(- -EXTRACTABLE BASES 5B4A- -)					ACTY	AL	(CAT EXCH)	RATIO	RATIO	CA	(BASE SAT)	
	6A1A	6B1A	C/N	6C2A	6S1A	6N2E	6O2D	6P2A	6Q2A		6H1A	6G1D	5A3A	5A6A	8D1	8C3	5F	5C3	5C1
	ORGN	NITG		EXT	TOTL	CA	MG	NA	K	SUM	BACL	KCL	EXTB	NHAC	NHAC	CA	SAT	EXTB	NHAC
	CARB			FE						EXTB	TEA	EXT	ACTY		TO	TO	NHAC	ACTY	
CM	PCT	PCT		PCT	UG/G	(- - - - - - - - - - -MEQ / 100					G- - - - - - - - - - -)				CLAY	MG	PCT	PCT	PCT
000-5	6.66	.358	19	.7	360D														
005-18	.66	.038	17	.7	500D														
018-30	.34	.021	16	.7	155D														
030-48	.27	.016		.6	200D														
048-69	.15			.6	270D														
069-104	.11			.3	290D														
104-203	.CE			.5	300D														
005-8	1.63	.104	16	.7	310D														
000-15	1.29	.083	16	.3	300D														
015-30	.27	.018		.8	340D														

DEPTH	(SATURATED PASTE)			NA	NA	SALT	GYP	(- - - - - - - - - SATURATION EXTRACT 8A1- - - - - - - - -)									ATTERBERG	
	8E1	8C1B	8A	5D2	5E	8D5	6F1A	8A1A	6N1B	6O1B	6P1A	6C1A	6I1A	6J1A	6K1A	6L1A	6M1A	4F1	4F2
	REST	PH	H2O	ESP	SAR	TOTL		EC	CA	MG	NA	K	CO3	HCO3	CL	SO4	NO3	LQID	PLST
	CHP-					SOLU		MMHOS/										LMIT	INDX
CM	CM		PCT	PCT		PPM	PCT	CM	(- - - - - - - - - MEQ / LITER - - - - - - - - - -)									PCT	
000-5																			
005-18																			
018-30																			
030-48																			
048-69																			
069-104	12CCC		5.6	23.9			9C		.57										
104-203																			
005-8																			
000-15																			
015-30																			

IDENTIFICATION OF SPODIC HORIZON BY LABORATORY CRITERIA (E).

DEPTH	HORIZON	(PYROPHOSPHATE,PH10)		(CIT - DIT)		(PYROPHOSP)		PYRO	CEC
		6G5A	6G5A	6A1B	6C2A	6G7A	FE+AL	AL+C	FE+AL	-1/2
		EXT	EXT	EXT	EXT	EXT	/	/	/	CLAY
		FE	AL	C	FE	AL	CLAY	CLAY	C - C	X
		PCT	PCT	PCT	PCT	PCT			FE+AL	THIC
005-18	B21HIR	.4	.2	.3	.7		.1	.1		

(A) THIN DISCONTINOUS A2 HORIZON.
(B) SAMPLES OBTAINED FROM CULTIVATED FIELD ABOUT 200 METERS FROM SITE.
(C) SIEVED SAMPLE (4B1A).
(D) UG/G - PERCHLORIC ACID DIGESTION, AMMONIUM MOLYBDATE AND STANNOUS CHLORIDE ACID COLORIMETRY. ANALYSIS BY M. SINGER INSTITUTE OF AGRICULTURE, UNIVERSITY OF MINNESOTA, ST. PAUL, MINNESOTA.
(E) SOIL SURVEY INVESTIGATIONS UNIT, BELTSVILLE, MARYLAND.

Pedon classification: Typic Udipsamment; mixed, frigid.
Series classification: Same.
Soil: Omega.
Soil No.: S68MN-9-5.
Location: Carlton County, Minnesota; SE1/4, SW1/4, NW1/4, Sec. 18, T. 47 N., R. 17 W.; 660 feet east of bridge and 120 feet north of east-west road; about 92 deg. 32 min. west longitude and 46 deg. 33 min. north latitude.
Climate: Humid continental. Some characteristics of temperature in deg. F. are: annual normal - 40, winter normal - 12, summer normal - 65; some characteristics of precipitation in inches are mean annual - 28, May to September - 19, mean snowfall - 55.
Parent material: Noncalcareous reddish brown sandy outwash of Nickerson phase of the Superior Lobe of the Late Wisconsin glaciation.
Physiography: Central Lowlands; Barnum Clay-till Area (H. E. Wright, 1972); valley train of the Blackhoof River.
Landscape setting: Site has 1/2 percent convex slope. The general area is nearly level with relative relief of 10 feet. Elevation is 1,090 feet.
Vegetation: Coniferous forest, mostly red pine with some white and jack pine; understory of bracken fern, clintonia, canadian mayflower, and few hazel; site index for red pine - 67, white pine - 66, jack pine - 73.
Drainage: Somewhat excessively drained.
Erosion: None.
Ground water: Deeper than 2 m.
Permeability: Rapid.
Moisture: Moist throughout.
Described by: R. Lewis and H. Finney on October 9, 1968.
Sampled by: L. Shields, G. Holmgren, and R. Rust on October 9, 1968.

O 1 to 0 cm (1/2 to 0 inches) Pine needles, branches and twigs in varying state of decomposition.

A1 68L1152 0 to 5 cm (0 to 2 inches) Black (10YR 2/1) loamy sand; moderate fine granular structure; very friable; few charcoal fragments; abundant very fine and medium random roots; about 0.5 percent coarse fragments ranging from 3 to 6 mm; abrupt wavy boundary. (3 to 5 cm thick)

A2 68L1159 5 to 8 cm (2 to 3 inches) Discontinuous horizon occupying about 75 percent of the pedon pit and ranging from 0 to 4 cm thick; reddish gray (5YR 5/2) loamy sand; weak fine subangular blocky structure; abundant very fine and medium random roots; very friable; abrupt wavy boundary.

B21hir 68L1153 5 to 18 cm (2 to 7 inches) Reddish brown (5YR 4/4) loamy sand; weak fine subangular blocky structure; very friable; abundant fine through coarse random roots; about 0.5 percent coarse fragments ranging from 3 to 6 mm; gradual smooth boundary. (8 to 13 cm thick)

B22hir 68L1154 18 to 30 cm (7 to 12 inches) Reddish brown (5YR 4/4) sand; weak fine subangular blocky structure with a few weak medium subangular blocky peds; loose; abundant medium and coarse vertical roots; about 0.5 percent coarse fragments ranging from 3 to 6 mm; gradual smooth boundary. (10 to 13 cm thick)

B23hir 68L1155 30 to 48 cm (12 to 19 inches) Reddish brown (5YR 4/4) grading to (5YR 5/3) sand; weak fine and medium subangular blocky structure; loose; abundant medium and coarse vertical roots; about 0.5 percent coarse fragments ranging from 3 to 6 mm; gradual smooth boundary.

B31 68L1156 48 to 69 cm (19 to 27 inches) Reddish brown (5YR 5/3) sand; weak fine and medium subangular blocky structure with a few 10 to 20 cm weakly coherent chunks; loose; abundant medium and coarse vertical roots; about 1 to 2 percent coarse fragments ranging from 3 to

SOIL CLASSIFICATION-TYPIC UDIPSAMMENT
MIXED, FRIGID
SERIES - - - - - - -OMEGA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, MTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

SOIL NO - - - - - - S68MN-9-8 COUNTY - - - CARLTON

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 68L1162-68L1169 FEBRUARY 1977

DEPTH CM	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B, PCT LT 2MM: SAND 2-.05	SILT .05-.002	CLAY LT .002	FINE CLAY LT .0002	VCOS SAND 2-1	CORS SAND 1-.5	MEDS SAND .5-.25	FNES SAND .25-.10	VFNS SAND .10-.05	COSI SILT .05-.02	FNSI SILT .02-.002	VFSI SILT .005-.002	FAML TEXT SAND 2-.1	INTR TEXT .2-.02	FINE CLAY TO CLAY	NON-CO3-CLAY	RATIO 8D1 15-BAR TO CLAY
000-5	A1	88.4	8.1	3.5		.6	11.2	31.3	42.0	3.4	3.0	5.1		85.0	21.3			2.54
005-10	B1	91.5	5.9	2.6		.5	8.4	28.6	48.9	5.1	2.1	3.8		86.4	26.6			.85
010-20	B21HIR	91.4	5.5	3.1		.9	13.5	34.5	39.6	2.9	1.4	4.1		88.5	18.1			.52
020-33	B22HIR	90.3	6.5	3.2		.8	11.3	30.0	44.4	3.8	2.3	4.2		86.5	23.1			.69
033-64	B31	94.4	3.6	2.0		1.1	10.6	32.3	46.5	3.9	1.5	2.1		90.5	23.2			.90
064-112	B32	96.9	2.5	.6		.4	7.8	28.3	52.0	8.4	2.0	.5		88.5	32.9			
112-152	C1	97.0	2.8	.2		.3	4.8	27.1	58.0	6.6	2.2	.6		90.3	32.8			
152-173	C2	94.6	5.0	.4		.6	5.9	24.0	51.6	12.5	4.7	.3		82.1	40.0			

DEPTH CM	(PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B21(VOL. GT 2 PCT	WEIGHT GT 75 PCT	75-20	20-5	5-2	LT .074 PCT LT 75	2C-2 .074 LT 2	BULK DENSITY 4A1D 1/3- BAR	4A1H OVEN DRY	4D1 COLE	(- - - -WATER CONTENT- - - -) 4B1C 1/10 BAR	4B1C 1/3- BAR	4B2 15- BAR	4C1 WRD CM/CM	CARBONATE 6E1B LT 2 PCT	3A1A LT .002 PCT	(- -PH - -) 8C1A 1/1 H2O	8C1E 1/2 CACL
000-5	[illegible]																	
005-10	0	0	0	0	0	10	0				7.6A		2.2		8.8		4.9	3.9
010-20	TR	0	0	0	TR	9	TR				7.8A		1.6		9.8		5.3	3.6
020-33	0	0	0	0	0	11	0				6.8A		2.2		8.8		5.5	4.5
033-64	TR	0	0	0	TR	7	TR				4.1A		1.0		6.4		5.4	4.6
064-112	0	0	0	0	0	6	0				3.3A		.5		6.6		5.6	4.7
112-152	0	0	0	0	0	5	0				2.5A		.3		4.0		5.7	4.6
152-173	TR	0	0	TR	TR	11	TR				3.4A		.4		8.5		5.9	4.6

DEPTH CM	(ORGANIC MATTER 6A1A	6B1A	C/N	IRON 6C2A	PHOS 6S1A	(- -EXTRACTABLE BASES 5B4A- -) 6N2E	6D2D	6P2A	6Q2A	ACTY 6H1A	AL 6G1D	(CAT EXCH) 5A3A	5A6A	RATIO 8D1	RATIO 8D3	CA 5F	(BASE SAT) 5C3	5C1
000-5	[illegible]																	
005-10																		
010-20																		
020-33																		
033-64																		
064-112																		
112-152																		
152-173																		

CM	CARB PCT	PCT	FE PCT	UG/G	EXTB (- - - - - - - - - - -MEQ / 100 G- - - - - - - - - - -)	TEA	EXT	ACTY	TO CLAY	TO MG	NHAC PCT	ACTY PCT	PCT
000-5	8.5C		.3	190B									
005-10	.91		.3	90B									
010-20	.34		.4	290B									
020-33	.2C		.4	210B									
033-64	.12		.3	300B									
064-112	.C5		.2	215B									
112-152	.C4		.2	165B									
152-173	.C7		.1	245B									

IDENTIFICATION OF THE SPODIC HORIZON BY LABORATORY CRITERIA (C),
(PYROPHOSPHATE,PH10) (CIT - DIT) (PYROPHOSP)

DEPTH	HORIZON	6C5A EXT FE PCT	6G5A EXT AL PCT	6A1B EXT C PCT	6C2A EXT FE PCT	6G7A EXT AL PCT	FE+AL / CLAY	AL+C / CLAY	PYRC FE+AL C - D X THIC	CEC -1/2 CLAY
C1C-2C	B21HIR	.3	.2	.3	.4		.2	.2		

(A) SIEVED SAMPLE (4B1A).
(B) UG/G - PERCHLORIC ACID DIGESTION, AMMONIUM MOLYBDATE AND STANNOUS CHLORIDE ACID COLORIMETRY. ANALYSIS BY M. SINGER INSTITUTE OF AGRICULTURE, UNIVERSITY OF MINNESOTA, ST. PAUL, MINNESOTA.
(C) SOIL SURVEY INVESTIGATIONS UNIT, BELTSVILLE, MARYLAND.

Pedon classification: Typic Udipsamment; mixed, frigid.
Series classification: Same.
Soil: Omega.
Soil No.: S68MN-9-8.
Location: Carlton County, Minnesota; NW1/4, NW1/4, SE1/4, Sec. 28, T. 46 N., R. 17 W. About 250 feet east of north-south road along trail and 60 feet south. About 92 deg. 30 min. west longitude and 56 deg. 26 min. north latitude.
Climate: Humid continental. Some characteristics of temperature in deg. F. are: annual normal - 40, winter normal - 12, summer normal - 65; some characteristics of precipitation in inches are: mean annual - 28, May to September - 19, mean snowfall - 55.
Parent material: Noncalcareous reddish brown sandy outwash of Nickerson phase of the Superior Lobe of the Late Wisconsin glaciation.
Physiography: Central Lowlands; Outwash plain near border between the Barnum Clay-till Area and Glacial Lake Duluth Area (H. E. Wright, 1972).
Landscape setting: Pedon has a 1 percent convex north facing slope. The immediate area is undulating with relative relief of about 10 feet. Soils of the Omega series are dominant in the immediate vicinity.
Vegetation: Coniferous forest; chiefly jack pine about 4 to 8 inches DBH; understory of blueberry, bearberry, and sweet fern.
Drainage: Somewhat excessively drained.
Erosion: None.
Ground water: Deeper than 2 m.
Permeability: Moderately rapid.
Moisture: Moist throughout.
Described by: R. Lewis and H. Finney on October 10, 1968.
Sampled by: L. Shields and G. Holmgren on October 10, 1968.

O 1 to 0 cm (1/2 to 0 inches) Pine needles, branches and twigs in varying states of decomposition.

A1 68L1162 0 to 5 cm (0 to 2 inches) Black (10YR 2/1) loamy sand; weak fine granular structure; very friable; few charcoal fragments; about 5 percent clean sand particles; abundant mostly medium and coarse random roots; abrupt wavy boundary. (1 to 5 cm thick)

B1 68L1163 5 to 10 cm (2 to 4 inches) Reddish brown (5YR 4/4) light loamy sand; weak fine and very fine subangular blocky structure; very friable; about 10 percent discontinuous dark reddish gray (5YR 4/2) in upper part ranging to 2 cm in thickness; abundant medium and coarse random roots; abrupt wavy boundary. (1 to 5 cm thick)

B21hir 68L1164 10 to 20 cm (4 to 8 inches) Dark reddish brown (5YR 3/4) grading to reddish brown (5YR 4/4) light loamy sand; massive breaking to weak fine subangular blocky fragments; very friable; loose; plentiful medium and coarse random roots; gradual smooth boundary. (8 to 15 cm thick)

B22hir 68L1165 20 to 33 cm (8 to 13 inches) Reddish brown (5YR 4/4) sand; single grain and some weak fine and medium subangular blocky structure; loose; plentiful medium and coarse vertical roots; gradual wavy boundary. (10 to 15 cm thick)

B31 68L1166 33 to 64 cm (13 to 25 inches) Reddish brown (5YR 5/4) sand; single grain and a few weakly coherent masses; loose; few medium vertical roots; diffuse wavy boundary.

B32 68L1167 64 to 112 cm (25 to 44 inches) Reddish brown (5YR 5/4) grading to (5YR 5/3) sand; single grain and a few weakly coherent masses; loose; very few medium vertical roots; diffuse smooth boundary.

C1 68L1168 112 to 152 cm (44 to 60 inches) Reddish brown (5YR 5/3) sand; single grain and a few weakly coherent masses; loose; very few medium vertical roots; clear smooth boundary.

C2 68L1169 152 to 173 cm (60 to 68 inches) Light reddish brown (5YR 6/3) grading to reddish brown (5YR 5/3) sand; single grain; very friable; loose; few thin horizontal strata of mostly fine and very fine sand; very few roots.

Remarks: Colors are for moist soil unless otherwise indicated. Samples were obtained from a pit with dimensions of about 1 by 1 by 2 m in depth. Due to darkness, color was determined under artificial light. The C1 horizon was sampled between depths of 132 to 147 cm.

SOIL CLASSIFICATION-TYPIC EUTROCHREPT
FINE-LOAMY, MIXED, MESIC
SERIES - - - - - - -RACINE TAXADJUNCT

SOIL NO - - - - - - S70MN-20-1 COUNTY - - - DODGE

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 70L1059-70L1067

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, MTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B																RATIO
					FINE	SAND					SILT			FAML	INTR	FINE	NON-	8D1
		SAND	SILT	CLAY	CLAY	VCOS	CORS	MEDS	FNES	VFNS	COSI	FNSI	VFSI	TEXT	II	TO	CO3-	15-
		2-	.05-	LT	LT	2-	1-	.5-	.25-	.10-	.05	.02	.005-	SAND	.2-	CLAY	CLAY	BAR
		.05	.002	.002	.0002	1	.5	.25	.10	.05	.02	.002	.002	2-.1	.02			TO
CM		PCT LT 2MM														PCT	PCT	CLAY
000-15	AP	24.7	49.0	26.3	15.3	.8	4.5	5.3	8.8	5.3	21.7	27.3	4.9	19.4	31.4	58	26	.46
015-23	A2	18.9	53.1	28.0	17.2	.7	3.0	3.8	6.6	4.8	22.9	30.2	5.7	14.1	31.2	61	28	.41
023-38	B2t	26.8	47.2	26.0	15.8	1.6	4.1	4.9	9.6	6.6	21.6	25.6		20.2	33.3	61	26	.40
038-61	2B22t	49.7	27.5	22.8	15.3	4.9	7.9	9.2	17.3	10.4	12.7	14.8		39.3	32.3	67	23	.38
061-97	2B23t	50.5	29.2	20.3	12.7	3.6	8.4	9.7	18.1	10.7	13.2	16.0		39.8	33.4	63	20	.42
097-119	2C1	48.8	34.8	16.4	5.5	4.2	8.3	8.9	16.8	10.6	15.3	19.5		38.2	34.9	34	13	.43
119-146	2C2	43.5	37.2	19.3	5.1	3.1	6.7	8.1	15.4	10.2	15.6	21.6		33.3	34.0	26	16	.43
146-181	3C3	47.6	34.4	18.0	6.7	3.6	7.5	8.8	16.6	11.1	15.6	18.8		36.5	35.6	37	15	.43
181-300	3C4	49.1	33.8	17.1	6.3	4.8	7.8	9.2	16.6	10.7	15.5	18.3	5.6	38.4	34.9	37	17	.43

DEPTH	(PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2)					BULK DENSITY				WATER CONTENT			CARBONATE		(-PH-)	
	VOL.	WEIGHT				4A1D	4A1H	4D1	4B1C	4B1C	4B2	4C1	6E1B	3A1A	8C1A	8C1E
	GT	GT	75-20	20-5	5-2	LT	20-2	1/3-	OVEN	COLE	1/10	1/3-	15-	WRD	LT	LT	1/1	1/2
	2	75				.074	PCT	BAR	DRY		BAR	BAR	BAR	CM/	2	.002	H2O	CACL
CM	PCT	PCT	PCT LT 75			LT20		G/CC	G/CC		PCT	PCT	PCT	CM	PCT	PCT		
000-15	TR	0	0	TR	TR	78	TR	1.39	1.55	.038	27.0	25.4	12.0	.19			5.9	5.8
015-23	TR	0	0	TR	TR	84	TR	1.37	1.47	.024	27.3	25.4	11.5	.19	2.6B		5.9	5.6
023-38	TR	0	0	TR	TR	77	TR	1.41	1.52	.026	23.0	21.7	10.5	.16	3.5B		5.4	5.1
038-61	2	0	0	1	2	54	3	1.49	1.65	.034	17.9	16.7	8.7	.12	2.1B		5.5	5.1
061-97	2	0	0	2	2	53	4	1.51	1.66	.031	16.7	15.4	8.6	.10	2.6B	TR	7.2	6.8
097-119	2	0	TR	1	3	54	4	1.76	1.83	.013	14.3	13.3	7.0	.11		19	3 7.9	7.7
119-146	2	0	0	1	2	60	3	1.80A					8.2			19	3 8.2	7.8
146-200	3	0	0	2	3	56	5	1.85	1.94	.016	14.8	13.5	7.7	.10	2.5B	16	3 8.2	7.9
200-300		0	0	1	2	55	3						7.4			16	TR 8.2	7.7

DEPTH	(ORGANIC MATTER)			IRON	PHOS	(-EXTRACTABLE BASES 5B4A-)					ACTY	AL	(CAT EXCH)		RATIO	RATIO	CA	(BASE SAT)	
	6A1A	6B1A	C/N	6C2B		6N2E	6Q2D	6P2B	6Q2B		6H1A	6G1E	5A3A	5A6A	8D1	8D3	5F1	5C3	5C1
	ORGN	NITG		EXT	TOTL	CA	MG	NA	K	SUM	BACL	KCL	EXTB	NHAC	NHAC	CA	SAT	EXTB	NHAC
	CARB			FE						EXTB	TEA	EXT	ACTY		TO	TO	NHAC	ACTY	
CM	PCT	PCT		PCT	PCT	(- - - - - - - - - -MEQ / 100 G- - - - - - - - - - - -)									CLAY	MG	PCT	PCT	PCT
000-15	2.54C	.232	11	1.0		15.2	4.7	0.1	0.6	20.6	15.1		35.7	22.3	0.85	3.2	68	57	92
015-23	1.38	.135	10	1.0		14.2	4.4	0.2	0.3	19.1	8.4		27.5	20.9	0.75	3.2	68	69	91
023-38	0.63	.055	11	1.1		12.6	3.8	0.2	0.4	17.0	7.1	0.3	24.1	18.9	0.73	3.3	67	71	90
038-61	0.24			1.1		10.6	3.1	0.2	0.4	14.3	4.4	0.3	18.7	14.7	0.64	3.4	72	76	97
061-97	0.11			1.1		13.6	3.2	0.2	0.3	17.3	2.0		19.3	12.7	0.63	4.3			
097-119	0.06			0.9		14.8D	1.7D	0.2	0.2	16.9				8.2	0.63E				
119-146	0.04			1.2		15.9D	2.1D	0.2	0.3	18.5				9.7	0.61E				
146-200	0.03			0.8		15.1D	2.0D	0.2	0.3	17.6				8.8	0.59E				
200-300	0.08			0.6		14.3D	1.8D	0.2	0.3	16.6				8.0	0.47				

DEPTH	(SATURATED PASTE)			NA	NA	SALT	GYP	(- - - - - - - - - SATURATION EXTRACT 8A1- - - - - - - - -)									ATTERBERG	
	8E1	8C1B	8A	5D2	5E	8D5	6F1A	8A1A	6N1B	6Q1B	6P1B	6Q1B	6I1A	6J1A	6K1A	6L1A	6M1A	4F1	4F2
	REST	PH	H2O	ESP	SAR	TOTL		EC	CA	MG	NA	K	CO3	HCO3	CL	SO4	NO3	LQID	PLST
	OHM-					SOLU		MMHOS/										LMIT	INDX
CM	CM		PCT	PCT		PPM	PCT	CM	(- - - - - - - - - - MEQ / LITER - - - - - - - - - - -)									PCT	
000-15																		40F	15
015-23																			
023-38																			
038-61																		33F	18
061-97																			
097-119	3000	7.6	29.8	2		110		0.60	4.0	1.2	0.5	0.1							
119-146																			
146-200																		26F	13
200-300																			

ANALYSES BY MINNESOTA AGRICULTURAL EXPERIMENT STATION, ST PAUL, MN. MINERALOGY, X-RAY ANALYSIS. TOTAL PHOSPHORUS, NITRIC-PERCHLORIC DIGESTION. AVAILABLE PHOSPHORUS, BRAY'S NO 1 EXTRACTANT.

DEPTH	(----------MINERALOGY----------)					TOTAL	AVAIL
	MONT	VERM	ILLITE	KAOL	QUARTZ	P	P
CM	(-------PCT LT .002 MM---------)					(--LBS/A---)	
000-15	40	0	45	10	5	1390	28
015-23	30	20	35	10	5		7
023-38	40	20	30	5	5	700	6
038-61	30	20	35	10	5		22
061-97	40	20	25	10	5	900	25
097-119	40	20	30	5	5		3
119-146	25	20	40	10	5	970	2
146-200	30	15	40	10	5		3
200-300	30	15	40	10	5	920	6

(A) ESTIMATED.
(B) MICRO-PENETRATION RESISTANCE - A ROD 0.6 CM DIA IS SLOWLY PUSHED INTO BULK DENSITY CLOD, EQUILIBRATED AT 1/10-BAR, A DISTANCE OF 0.6 CM USING A POCKET PENETROMETER. UNITS ARE FORCE (KG) AND NOT ESTIMATES OF UNCONFINED COMPRESSIVE STRENGTH.
(C) ORGANIC CARBON IS 10 KG/M SQ TO A DEPTH OF 1 M (6A).
(D) METHOD 6N4C FOR CA AND 6O4C FOR MG.
(E) METHOD 8D2.
(F) DETERMINED BY SOIL MECHANICS LAB - SCS, LINCOLN, NE.

Pedon classification: Typic Eutrochrept; fine-loamy, mixed, mesic*.
Series classification: Mollic Hapludalfs; fine-loamy, mixed, mesic.
Soil: Racine taxadjunct*.
Soil No.: S70MN-20-1.
Location: Dodge County, Minnesota; about 4 miles north of Hayfield, Minnesota; 380 feet south and 610 feet west of the northeast corner of SE1/4 of NW1/4, Sec. 35, T. 106 N., R. 17 W. About 92 deg. 50 min. west longitude, and about 43 deg. 57 min. north latitude.
Climate: Humid continental. Some features of precipitation in inches: annual normal - 29, May through September - 19, annual normal snowfall - 40. Some features of temperature in deg. F.: annual normal - 45, summer normal - 70, winter normal - 18.
Parent material: Loamy mantle (loess?) over loamy calcareous Kansan(?) till with a thin intervening stone line.
Physiography: Central Lowlands; Iowan Erosion Surface (Ruhe); Rochester Till Plain (Wright); Kenyon-Taopi Plain, silty, undulating (MN Soil Atlas).
Landscape setting: Site has 4 percent southeast facing slope on a shoulder which is adjacent to a drainageway. Topography in the immediate vicinity is gently rolling. Relative relief in the immediate vicinity is about 20 feet. Elevation is about 1,305 feet. Major soils in the area are of the Kasson, Skyberg, and Racine series.
Vegetation: Corn field. Native vegetation was tall grass prairie or savanna.
Drainage: Well drained.
Erosion: Slight
Moisture: Moist to wet; area recently had prolonged heavy rains; downslope seepage filled pit to within 15 inches of the surface.
Root distribution: Common to 24 inches, few to 48 inches.
Permeability: Moderate in upper part of solum grading to slow or moderately slow in the IIC horizon.
Described by: J. F. Cummins on October 19, 1970.
Sampled by: R. B. Grossman, E. R. Gross, and J. F. Cummins on October 19, 1970.

Ap 70L1059 0 to 15 cm (0 to 6 inches) Very dark gray (10YR 3/1) loam high in content of silt, very dark grayish brown (10YR 3/2) rubbed, dark gray (10YR 4/1) to gray (10YR 5/1) dry; weak fine subangular blocky structure; friable; less than 1 percent coarse fragments; abrupt smooth boundary.

A2 70L1060 15 to 23 cm (6 to 9 inches) Dark brown (10YR 3/3) loam high in content of silt, dark yellowish brown (10YR 3/4) rubbed, about 10 percent very dark gray (10YR 3/1) wormcasts; grayish brown (10YR 5/2) and brown (10YR 5/3) dry; weak thin platy structure; friable; less than 1 percent coarse fragments; abrupt smooth boundary.

B21t 70L1061 23 to 38 cm (9 to 15 inches) Dark yellowish brown (10YR 5/4) (10YR 5/3, dry) loam high in content of silt, brown (10YR 4/3) (10YR 5/3 and 6/3, dry) coatings on faces of peds, about 5 percent dark grayish brown (10YR 3/1) wormcasts; weak fine subangular blocky structure; friable; few clean sand particles on faces of peds; a few thin clay films in pores; abrupt wavy boundary.

IIB22t 70L1062 38 to 61 cm (15 to 24 inches) Yellowish brown (10YR 5/4) loam, dark yellowish brown (10YR 4/4) (10YR 6/4, dry) coatings on faces of peds; weak and moderate, fine and medium prismatic structure parting to weak and moderate, fine and medium subangular blocky structure; friable; few clean sand particles on faces of peds; few thin clay films in pores; about 4 percent coarse fragments with more larger fragments, coarse gravel and cobbles, in upper part; clear wavy boundary.

IIB23t 70L1063 61 to 97 cm (24 to 37 inches) Yellowish brown (10YR 5/6 and 5/8 loam with yellowish brown (10YR 5/4) coatings on faces of peds; moderate fine and medium prismatic structure; friable; few clean sand particles on faces of peds; few thin clay films on faces of peds and in pores; about 4 percent coarse fragments; clear wavy boundary.

IIC1 70L1064 97 to 119 cm (38 to 47 inches) Yellowish brown (10YR 5/6 and 5/8) loam; moderate medium and coarse prismatic structure; firm; few lime concretions and soft filaments on ped faces; about 6 percent coarse fragments; clear wavy boundary.

IIC2 70L1065 119 to 146 cm (47 to 58 inches) Yellowish brown (10YR 5/6 and 5/8) sandy clay loam; common medium distinct grayish brown (10YR 5/2) mottles; moderate medium and coarse prismatic structure; firm; few soft lime filaments; about 6 percent coarse fragments; clear wavy boundary.

IIIC3 70L1066 146 to 181 cm (58 to 72 inches) Light olive brown (2.5Y 5/4) loam; many medium prominent yellowish brown (10YR 5/8) and grayish brown (10YR 5/2) mottles; moderate medium and coarse prismatic structure; firm; few lime filaments on faces of peds; about 6 percent coarse fragments.

IIIC4 70L1067 181 to 300 cm (72 to 112 inches) Not described.

Remarks: A pedon each of the Kasson (S70MN-20-2) and the Skyberg (S70MN-20-3) was sampled in the immediate vicinity. Samples were collected from a pit that was dug with a backhoe.

*Because of the rather slight evidence of illuviation of clay in this pedon, a more realistic classification is in Typic Eutrochrepts. Perhaps the series also should be placed in Eutrochrepts.

SOIL CLASSIFICATION-TYPIC BOROHEMIST [redacted]

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE, MTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

SERIES - - - - - - -EUIC -RIFLE

SOIL NO - - - - - - S73MN-69-1 COUNTY - - - ST. LOUIS

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 73L607-73L615 MARCH 1977

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B														RATIO	
		SAND 2- .05	SILT .05- .002	CLAY LT .002	FINE CLAY LT .0002	SAND VCOS 2- 1	CORS 1- .5	MEDS .5- .25	FNES .25- .10	VFNS .10- .05	SILT COSI .05 .02	FNSI .02 .002	VFSI .005- .002	TEXT SAND 2-.1	INTR II .2- .02	FINE CLAY TO CLAY	NON- C03- 15- BAR TO CLAY
CM		PCT LT 2MM														PCT	PCT
0-25	0AP																
25-60	0E1 (A)																
60-70	0E2																
70-130	0E3 (B)																
130-165	0A2																
165-180	0A3																

DEPTH	HISTOSOL CHARACTERIZATION (STATE OF DECOMPOSITION) 8F MINL CONT	8G (FIBER VOL) RUBB	8H PYROPHOSPHT SOLUBILITY	PH 8C1E .01M CACL	(BULK DEN) 4A3A FILD STAT	4A1I 1/3B RENT	COLE 4D1 RE- WET	SUBS RES- IDUE	(- -WATER CONTENT- -) 4B4 FILD STAT	4B1C 1/3B RENT	4B2 15- BAR	4C1 WRD CM/	SHEAR STRENGTH (C)
CM	PCT	PCT	PCT			G/CC	G/CC		PCT	PCT	PCT	PCT	CM	KPA
0-25	19	53	3	10YR	4/3	5.1	.20		60	340				
25-60	8	65	20	10YR	8/3	4.8	.13		66	580				
60-70	10	44	17	10YR	7/3	4.8				690				8.2
70-130	10	72	21	10YR	7/3	5.0	.12		60	720				12.7
130-165	10	32	7	10YR	6/3	5.3	.13		65	705				11.7
165-180	23	10	3	10YR	4/2	5.3	.15		64	520				

(A) RESULTS FOR 73L608, 73L609, 73L610 AVERAGED AND REPORTED FOR OE1 HORIZON.
(B) RESULTS FOR 73L612 and 73L613 AVERAGED AND REPORTED FOR OE3 HORIZON.
(C) KPA = KILOPASCAL.

Pedon classification: Typic Borohemist; euic.
Series classification: Same.
Soil: Rifle series.
Soil No.: S73MN-69-1.
Location: St. Louis County, Minnesota; about 1 mile north of Sax; 100 feet south and 50 feet west of the northeast corner of field No. 5, Wilderness Farm Experimental Area, in the NE 1/4, NW 1/4, Sec. 26, T. 55 N., R. 18 W.; about 47.2 deg. north latitude and about 92.6 deg. west longitude.
Climate: Humid continental. Mean annual temperature is 38 deg.F.; mean summer temperature is 63 deg.F.; and mean winter temperature is 10 deg.F. Mean annual precipitation is 28 inches; May through September precipitation is 18 inches; mean annual snowfall is 60 inches; frost-free period is 84 days.
Parent material: Organic soil material derived primarily from herbaceous plants over loamy glacial lacustrine sediments of Late Wisconsin age.
Physiography: Central lowlands; Upham Lacustrine Plain. Site is about 10 miles from the border of the plain and the morainic uplands. The lacustrine plain is level in this vicinity. Elevation is about 1,318 feet. Slope of bog is about 5 feet per mile to the southwest.
Vegetation: Cultivated field.
Distance to adjacent mineral land: About 3 miles.
Microrelief: None
Depth to water table: About 30 inches.
Subsidence: Slight; ditches at intervals of about 100 feet.
Observers: Pedon was first described by R. S. Farnham and H. R. Finney on Sept. 1, 1966. Samples were collected, shear strength was measured, and some additional notes on morphology were obtained on July 9, 1973 by E. L. Bruns, J. H. Day, L. Dunnigan, R. S. Farnham, H. R. Finney, M. Levesque, W. C. Lynn, and W. E. McKinzie. Samples were obtained from a hand-dug pit, with a spade, and with the Macaulay peat sampler.

Oap 73I607 0 to 25 cm Very dark brown (10 YR 2/2, broken face) matrix and very dark grayish brown (10YR 3/2, broken face) fiber, sapric material, very dark brown (10YR 2/2, rubbed); about 20 percent fiber, about 5 percent rubbed; weak very fine and fine granular structure; very friable; mostly herbaceous fiber with about 5 percent woody fiber; about 15 percent mineral material;

abrupt smooth boundary.

(73I608, 73I609, 73I610)
Oe1 25 to 60 cm Dark brown (7.5YR 3/2, broken face) matrix and dark yellowish brown (10YR 3/4, broken face) fiber, hemic material, very dark grayish brown (10YR 3/2, rubbed); about 70 percent fiber, about 40 percent rubbed; very weak thin through thick platy structure; nonsticky; mostly herbaceous fiber with a trace of woody fiber; about 8 percent mineral material; clear smooth boundary.

Oe2 73I611 60 to 70 cm Very dark brown (10YR 2/2, broken face) matrix and dark yellowish brown (10YR 4/4, broken face) fiber, hemic material, black (10YR 2/1, rubbed); about 50 percent fiber, about 30 percent rubbed; massive; slightly sticky; about 75 percent herbaceous fiber and about 25 percent woody fiber; about 25 percent woody fragments as large as 10 cm across and 50 cm in length; about 15 percent mineral material; clear smooth boundary.
(73I612, 73I613)
Oe3 70 to 130 cm Dark yellowish brown (10YR 4/4, broken face) hemic material, very dark brown (10YR 2/2, rubbed); about 60 percent fiber, about 40 percent after rubbing; massive; nonsticky, herbaceous fiber; about 10 percent mineral material; gradual smooth boundary.

Oa2 73I614 130 to 165 cm Very dark brown (10YR 2/2, broken face) matrix and very dark grayish brown

SOIL CLASSIFICATION-TYPIC CALCIAQUOLL
COARSE-LOAMY, FRIGID
SERIES - - - - - - -ROCKWELL

SOIL NC - - - - - - S67MN-84-3 COUNTY - - - WILKIN

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 67L602-67L609

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, MTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

FEBRUARY 1977

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B															RATIO
		SAND 2- .05	SILT .05- .002	CLAY LT .002	FINE CLAY LT .0002	SAND VCOS 2- 1	SAND CORS 1- .5	SAND MEDS .5- .25	SAND FNES .25- .10	SAND VFNS .10- .05	SILT COSI .05 .02	SILT FNSI .02 .002	SILT VFSI .002- .002	FAML TEXT SAND 2-.1	INTR II .2- .02	FINE CLAY TO CLAY	NON- CO3- CLAY PCT	801 15- BAR TO CLAY
CM		PCT LT 2MM															PCT	PCT
[illegible]																		

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2					BULK DENSITY			WATER CONTENT			CARBONATE		
		VCL. GT 2	GT 75	75-20	20-5	5-2	LT .074	20-2	1/3- OVEN DRY	COLE	1/10 BAR	1/3- BAR	15- BAR	WRD	6E1B LT 2	3A1A LT .002	8C1A 1/1 H2O
CM		PCT	PCT	PCT LT 75				LT20	G/CC	G/CC		PCT	PCT	PCT	CM/CM	PCT	PCT	
C36-53	C1GCA	63.3	14.6	22.1		.4	1.6	2.4	15.5	43.4	6.5	8.1		19.9	61.5		11	.34
C53-74	C2C	81.6	11.7	6.7		.7	3.0	4.2	23.8	49.9	5.9	5.8		31.7	73.3		7	.32
C74-86	C3C	66.8	21.4	11.8		1.2	2.9	4.9	30.5	27.3	9.8	11.6		39.5	59.2		12	.36
C86-97	2C4G	33.9	35.9	30.2		1.2	2.9	4.1	16.9	8.8	6.0	29.9		25.1	25.2		27	.40
C97-122	2C5G	11.4	55.8	32.8		.6	1.0	1.3	5.0	3.5	6.5	49.3		7.9	13.4			.42
122-152	2C6G	23.6	51.0	25.4		2.5	3.2	3.3	8.2	6.4	10.7	40.3		17.2	22.0		25	.49

DEPTH	ORGANIC MATTER 6A1A CRGN CARB	6B1A NITG	C/N	IRON 6C2A EXT FE	PHOS 6S1A TOTL	EXTRACTABLE BASES 5B4A- 6N2E CA	6O4C MG	6P2A NA	6Q2A K	SUM EXTB	ACTY 6H1A BACL TEA	AL 6G1C KCL EXT	CAT EXCH 5A3A EXTB ACTY	5A6A NHAC	RATIO BD2 NHAC TC	RATIO 8D3 CA TO MG	CA SAT NHAC PCT	BASE SAT 5C3 EXTB ACTY PCT	5C1 NHAC PCT
CM	PCT	PCT		PCT	PCT	MEQ / 100 G									CLAY				
000-20	3.27C					13.4	1.9	.7	37.0				23.6	1.18					
020-36	1.52					12.9	2.4	.3	28.6				15.0	.83					
036-53	.6C					8.6	2.1	.2	19.0				7.8	.71					
C53-74	.1C					5.1	1.1	.2	10.4				4.C	.57					
C74-86	.05					8.6	2.2	.3	15.4				7.4	.62					
C86-97	.11					18.5	4.6	.6	29.8				15.5	.57					
C97-122	.15																		
122-152	.11					20.1	5.8	.6	35.1				14.2	.57					

(A) ESTIMATED.
(B) 1/10-BAR, METHOD 4A1G.
(C) 14 KG OF CARBON PER SQ METER TO A DEPTH OF 1 METER, METHOD 6A.

Soil classification: Typic Calciaquoll; coarse-loamy, frigid.
Series: Rockwell series.
Pedon No.: S67MN-84-3.
Area: Wilkin County, Minnesota.
Location: NW¼NE¼SE¼ sec. 35, T. 132 N., R.46 W. (Sunny Side Twp.); 1,060 feet west and 320 feet south of the northeast corner of the southeast quarter.
Climate: Some characteristics of temperature in degrees F. are: annual normal - 43, winter normal - 13, summer normal - 70; some characteristics of precipitation in inches are: mean annual - 21, May to September - 14, mean annual snowfall - 40.
Vegetation: Soil bank field with brome grass, alfalfa, and quackgrass the dominant plants; native vegetation was species of the tall prairie plant formation.
Parent material: Moderately shallow, calcareous, loamy glacio-lacustrine sediments over calcareous,

[redacted]

Topography: Slope at site is level.
Drainage: Poorly drained.
Erosion: None.
Permeability: Moderate in the upper part, slow in the underlying material.
Sampled by: R. H. Jordan, G. S. Holmgren, R. A. Erickson, and H. R. Finney.
Described by: H. R. Finney.

Ap 67L602 0 to 20 cm (0 to 8 inches) Black (10YR 2/1) sandy clay loam; moderate fine and very fine granular structure; very friable; abundant roots; about 1 percent soft white crystalline bodies; strongly effervescent; abrupt smooth boundary.

A3 67L603 20 to 36 cm (8 to 14 inches) Very dark gray (10YR 3/1) sandy clay loam; about 20 percent fingers and coating of black (10YR 2/1); weak fine subangular blocky structure parting to weak very fine granular structure; very friable; abundant roots; strongly effervescent; clear wavy boundary.

C1gca 67L604 36 to 53 cm (14 to 21 inches) Dark gray (2.5Y 4/1) sandy clay loam; weak fine subangular blocky structure parting to weak very fine granular structure; very friable; plentiful roots; violently effervescent; clear wavy boundary.

C2g 67L605 53 to 74 cm (21 to 29 inches) Light brownish gray (2.5Y 6/2) loamy fine sand; common fine prominent dark brown (7.5YR 3/2) and very dark reddish brown (5YR 3/4) soft concretions; weak medium subangular blocky structure; very friable; plentiful roots; slightly effervescent; clear wavy boundary.

C3g 67L606 74 to 86 cm (29 to 34 inches) Light gray (5Y 7/2) fine sandy loam; common fine faint olive (5Y 5/3) mottles; weak fine subangular blocky structure; very friable; few roots; common fine very dark brown soft concretions 1.0 to 2.0 mm in diameter; slightly effervescent; clear wavy boundary.

IIC4g 67L607 86 to 97 cm (34 to 38 inches) Pale olive (5Y 6/3) clay loam; common fine distinct light olive brown (2.5Y 5/4) mottles; weak fine subangular blocky structure; friable; few roots; about 10 percent fine gravel; slightly effervescent; abrupt wavy boundary.

IIC5g 67L608 97 to 122 cm (38 to 48 inches) Light gray to light olive gray (5Y 6/1 to 5Y 6/2) silty clay loam; many fine distinct light olive brown (2.5Y 5/6) and few fine faint dark grayish brown (2.5Y 4/2) mottles; weak medium prismatic structure parting to medium very fine angular blocky structure; friable; few roots; a few shiny pressure faces some of which have sandy coatings about 1 [illegible]

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION: Aeric Fragiaqualf; coarse-loamy, mixed, frigid

SOIL Ronneby Series SOIL Nos. S63MN-5-5 LOCATION Renton County, Minnesota

SOIL SURVEY LABORATORY Lincoln, Nebraska LAB. Nos. 18857-18866 August 1967

General Methods: 1A, 1B1b, 2A1, 2B

Depth (in.)	Horizon	Size class and particle diameter (mm) 3A1 — Total: Sand (2–0.05)	Total: Silt (0.05–0.002)	Total: Clay (< 0.002)	Sand: Very coarse (2–1)	Sand: Coarse (1–0.5)	Sand: Medium (0.5–0.25)	Sand: Fine (0.25–0.1)	Sand: Very fine (0.1–0.05)	Silt: 0.05–0.02	Silt: Int. III (0.02–0.002)	Int. II (0.2–0.02)	(2–0.1)			Coarse fragments 2A2: 3B1 2–19 Wt. Pct.	3B2 2–19 Vol. Pct.	
		Pct. of < 2 mm																
0–4	Ap	43.1	37.2	19.7	0.6	5.7	10.8	18.0	8.0	16.5	20.7	33.1	35.1			tr		
4–7	A21g	54.4	36.5	9.1	1.4	8.0	12.5	22.3	10.2	16.9	19.6	38.2	44.2			tr		
7–12	A22g	56.3	34.5	9.2	2.7	7.7	12.1	22.9	10.9	16.4	18.1	38.9	45.4			6	4	
12–17	B1g	50.6	33.1	16.3	3.6	6.1	9.8	20.6	10.5	17.2	15.9	38.2	40.1			17	11	
17–25	B21g	55.6	27.0	17.4	3.6	6.5	11.1	22.3	12.1	13.8	13.2	36.5	43.5			10	6	
25–33	B22g	62.9	23.5	13.6	4.1	8.4	12.2	25.7	12.5	13.1	10.4	38.7	50.4			10	6	
33–45	Bx1	70.8	25.5	3.7	3.7	10.0	15.1	27.4	14.6	14.1	11.4	43.0	56.2			14	10	
45–56	Bx2	68.7	27.8	3.5	3.8	10.0	14.6	25.9	14.4	15.9	11.9	43.8	54.3			13	9	
56–61	C1x	57.6	36.6	5.8	4.0	7.9	11.8	21.1	12.8	18.9	17.7	42.6	44.8			11	8	
61–72	C2x	60.4a	31.2	8.4	4.7	9.0	12.6	22.3	11.8	14.0	17.2	37.3	48.6			13	10	

Depth (in.)	6A1a Organic carbon b Pct.	6B1a Nitrogen Pct.	C/N	Carbonate as $CaCO_3$: 6H1b 6H2a <2 mm. Pct.	3A1a <0.002 mm. Pct.	Bulk density: 4A1a Field-State g/cc	4A1d 1/3-Bar c g/cc	4A1d 1/3-Bar g/cc	4A1b Air-Dry g/cc	4III COLE	Water content: 4B4 Field-State Pct.	4B1c 1/3-Bar Pct.	4B2 15-Bar Pct.	4C1 1/3-to 15-Bar in./in.		pH		8C1a (1:1)
0–4	4.83	0.384	13			1.32		1.36	1.43	0.017	29.0	26.4	14.7	0.16				5.9
4–7	1.03	0.078	13			1.65		1.65	1.65	-	16.6	18.8	4.9	0.23				6.0
7–12	0.48	0.034	14			1.65	1.58	1.65	1.64		14.2	16.3	4.4	0.19				5.9
12–17	0.39	0.035	11			1.53	1.35	1.52	1.53	0.003	15.9	14.1	7.0	0.10				5.6
17–25	0.28	0.025	11			1.55	1.46	1.55	1.61	0.013	17.6	16.6	8.0	0.13				5.6
25–33	0.25					1.66	1.54	1.64	1.71	0.013	15.3	14.4	6.7	0.12				6.0
33–45	0.10			-(a)		1.80	1.61d	1.79d	1.81	0.003	13.1	8.6e	2.1	0.11f				7.0
45–56	0.08			-(a)		1.86	1.68d	1.85d	1.86	0.003	12.6	10.2e	1.8	0.15f				7.3
56–61	0.07			tr(a)	-	1.90	1.73d	1.88d	1.88	-	11.9	10.2e	2.5	0.13f				8.2
61–72	0.11			1	-	1.98	1.76d	1.96d	1.97	0.003	10.5	10.1e	3.5	0.12f				8.4

Depth (in.)	Extractable bases 6N2a Ca	6Q2a Mg	6P2a Na	5H1a 6Q2a K	Sum	6H1a Ext. Acidity	Cat. Exch. Cap. 5A3a Sum Cations	5A1a NH_4OAc	KCl-Ext. Al		Ext. Iron as Fe Pct.				8D3 Ca/Mg		Base saturation 5C3 Sum Cations Pct.	5C1 NH_4OAc Pct
	meq/100 g																	
0–4	21.6	3.1	0.1	0.2	25.0	13.0	38.0	26.9							7.0		66	93
4–7	6.5	1.1	0.1	0.1	7.8	5.3	13.1	9.1							5.9		60	86
7–12	4.0	1.3	0.1	0.1	5.5	4.5	10.0	6.5							3.1		55	85
12–17	6.0	3.4	0.1	0.2	9.7	5.6	15.3	11.4							1.8		63	85
17–25	6.9	4.6	0.1	0.2	11.8	6.0	17.8	13.6							1.5		66	87
25–33	7.5	4.6	0.1	0.2	12.4	4.1	16.5	12.5							1.6		75	99
33–45	3.0	1.6	0.1	0.1	4.8	1.5	6.3	4.5							1.9		76	107
45–56	2.5g	0.8h	0.1	0.1	3.5	0.8	4.3	3.6									81	97
56–61	3.9g	1.0h	0.1	0.1	5.1			4.9							3.9			
61–72	5.1g	1.4h	0.1	0.1	6.7			6.0							3.6			

Depth (in.)	Ratios to Clay 8D1: NH_4OAc CEC	Ext. Iron	15-Bar Water
0–4	1.37		0.75
4–7	1.00		0.54
7–12	0.71		0.48
12–17	0.70		0.43
17–25	0.78		0.46
25–33	0.92		0.49
33–45	1.22		0.57
45–56	1.03		0.51
56–61	0.84		0.43
61–72	0.71		0.42

a. Carbonate grains: 1-5 percent (0.5-0.05 mm).
b. 12 kg/m² to 60 inches (Method 6A).
c. Calculated to include volume but not weight of 2- to 19-mm material (Method 3B2).
d. 1/10-bar (Method 4A1g).
e. 1/10-bar (Method 4B1c).
f. 1/10- to 15-bar (Method 4C2).
g. NH_4Cl-EtOH extract (Method 6N3a).
h. NH_4Cl-EtOH extract (Method 6Q3a).

Soil classification: Aeric Fragiaqualf; coarse-loamy, mixed, frigid.
Soil: Ronneby series.
Soil Nos.: S63MN-5-5.
Area: Benton County, Minnesota
Location: SW¼ of NW¼ Sec. 6, T36N, R28W, in open wooded pasture 300 feet east of old township road.
Vegetation: Bluegrass pasture with scattered elm, oak, maple, prickly ash.
Parent material: Red till - sandy loam.
Physiographic position: Nearly level ground moraine.
Slope: 1 percent.
Erosion: None.
Drainage: Somewhat poor.
Permeability: Moderately slow
Ground water: 52 inches
Moisture: Wet
Stoniness: Surface stones and boulders are common. Described by: W. W. Anderson.
Sampled October 2, 1963, by W. W. Anderson, M. F. Grimes, R. S. Farnham, G. Holmgren and R. L. Juve.

Horizon	
Ap LSL 18857	0 to 4 inches, black (10YR 2/1) loam; moderate fine and very fine granular structure; very friable; pH 6.2: clear smooth boundary.
A21g LSL 18858	4 to 7 inches, very dark gray (10YR 3/1) and dark gray (10YR 4/1) loam to fine sandy loam with common fine distinct dark brown (10YR 4/3) to dark yellowish brown (10YR 4/4) mottles; moderate medium and thin platy structure; very friable; pH 6.2; clear smooth boundary.
A22g LSL 18859	7 to 12 inches, dark grayish brown (10YR 4/2) loam to fine sandy loam with common fine distinct dark brown (10YR 4/3), dark yellowish brown (10YR 4/4) and (10YR 3/4) mottles; moderate medium platy structure; friable; upper faces of plates have dark gray (10YR 4/1) stains with few dark brown (7.5YR 4/4) mottles; pH 6.1; clear smooth boundary.
B1g LSL 18860	12 to 17 inches, grayish brown (10YR 5/2) to brown (10YR 5/3) loam with many fine distinct dark brown (7.5YR 4/4 and 10YR 4/4) mottles; weak fine subangular blocky structure; friable; stone line in this horizon, cobbles 2-6 inches; pH 5.6; clear smooth boundary.
B21g LSL 18861	17 to 25 inches, dark brown (7.5YR 4/2) heavy loam with many fine faint brown (7.5YR 4/4) mottles; weak to moderate thick and medium platy structure; friable; occasionally major vertical cleavage faces coated with bleached sand; pH 5.4; gradual wavy boundary.
B22g LSL 18862	25 to 33 inches, finely mottled, dark brown (7.5YR 4/2 and 4/4), brown (7.5YR 5/2) and strong brown (7.5YR 4/6) heavy loam or clay loam; weak to moderate thick and medium platy structure; friable; moderately thick clay films in root channels; pH 5.6; clear wavy boundary.
Bx1 LSL 18863	33 to 45 inches, dark reddish gray (5YR 4/2) and reddish brown (5YR 4/3) sandy loam with many fine distinct reddish brown (5YR 4/4) and dark brown (7.5YR 4/4) mottles in the upper part of the horizon grading to few in the lower part; weak medium platy structure; friable, firm in place; stains of dark reddish brown (5YR 3/2-3/3) on surface of plates and around pebbles; pH 6.6; gradual wavy boundary.
Bx2 LSL 18864	45 to 56 inches, dark brown (7.5YR 3/3) and dark reddish brown (5YR 3/3) sandy loam to loamy sand; with few coarse faint dark reddish brown (2.5YR 3/4) and reddish brown (2.5YR 4/4) mottles; weak medium platy structure; friable, firm in place; pH 7.2; clear wavy boundary.
C1x LSL 18865	56 to 61 inches, reddish brown (5YR 4/4) sandy loam; weak thin and medium platy structure; friable to firm, very firm in place; pH 7.4; gradual wavy boundary.
C2x LSL 18866	61 to 72 inches, reddish brown (2.5YR-5YR 4/4) sandy loam; moderate to strong thin and medium platy structure; friable to firm, very firm in place; effervesces slightly with acid.

SOIL CLASSIFICATION-AERIC GLOSSAQUALF
FINE-LOAMY, MIXED, MESIC
SERIES - - - - - - - -SARGEANT TAXADJUNCT

SOIL NO - - - - - - - S70MN-50-1 COUNTY - - - MOWER

GENERAL METHODS- - -1A,1B1B,2A1,2B

SAMPLE NOS. 70L1109-70L1122

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, MTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

DEPTH	HORIZON	(- - - PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B - - -)																RATIO
					FINE	(- - SAND - -)					(- -SILT- -)			FAML	INTR	FINE	NON-	8D1
		SAND	SILT	CLAY	CLAY	VCOS	CORS	MEDS	FNES	VFNS	COSI	FNSI	VFSI	TEXT	II	CLAY	CO3-	15-
		2-	.05-	LT	LT	2-	1-	.5-	.25-	.10-	.05	.02	.005-	SAND	.2-	TO	CLAY	BAR
		.05	.002	.002	.0002	1	.5	.25	.10	.05	.02	.002	.002	2-.1	.02	CLAY		TO
CM		(- - - PCT LT 2MM - - -													)	PCT	PCT	CLAY
000-9	A1	11.3	62.0	26.7	17.1	.3	2.7	3.0	3.6	1.7	23.3	38.7		9.6	26.7	64		.70
009-19	A21	12.9	65.7	21.4	13.7	.5	3.1	3.5	4.1	1.7	24.0	41.7		11.2	27.5	64		.48
019-38	A22	10.1	67.7	22.2	12.2	.4	2.5	2.6	3.1	1.5	26.4	41.3		8.6	29.3	55		.43
038-56	A23	7.2	67.1	25.7	13.5	.4	1.6	1.7	2.0	1.5	28.9	38.2		5.7	31.3	53		.44
056-78	B&A	21.9	50.0	28.1	16.6	1.0	3.5	5.2	8.6	3.6	24.9	25.1		18.3	32.4	59		.43
078-101	2B&A	59.7	21.3	19.0	11.8	3.6	9.9	12.7	24.1	9.4	10.8	10.5		50.3	32.5	62		.38
101-135	2B21T	62.5	20.1	17.4	10.3	5.3	10.7	14.5	22.5	9.5	10.5	9.6		53.0	30.9	59		.36
135-170	2B22T	62.9	18.9	18.2	10.7	6.3	11.5	14.7	21.9	8.5	9.2	9.7		54.4	28.0	59		.36
170-205	2B3	63.2	19.7	17.1	10.3	6.1	12.6	12.9	22.5	9.1	9.5	10.2		54.1	28.8	60		.38
205-265	3C1	81.1	8.5	10.4		11.0	21.7	19.3	22.8	6.3	5.0	3.5		74.8	20.5			.43
265-315	3C2	78.8	12.1	9.1		6.3	15.8	18.5	28.0	10.2	8.0	4.1		68.6	30.3			.44
315-375	3C3	62.8	27.5	9.7		1.4	11.3	17.2	22.2	10.7	18.8	8.7		52.1	38.4			.42
375-435	3C4	87.2	6.2	6.6		7.4	25.4	26.7	24.0	3.7	3.3	2.9		83.5	15.4			.52
000-38	(A)	10.3	69.0	20.7		.3	2.4	2.6	3.1	1.9	26.6	42.4		8.4	23.9			.58

DEPTH	(PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2)							(BULK DENSITY)			(- - -WATER CONTENT- - -)				CARBONATE		(- -PH - -)	
	VOL.	(- - - WEIGHT - - -)						4A1D	4A1H	4D1	4B1C	4B1C	4B2	4C1	6E1B	3A1A	8C1A	8C1E
	GT	GT	75-20	20-5	5-2	LT	20-2	1/3-	OVEN	COLE	1/10	1/3-	15-	WRD	LT	LT	1/1	1/2
	2	75				.074	PCT	BAR	DRY		BAR	BAR	BAR	CM/	2	.002	H2O	CACL
CM	PCT	PCT	(- - - PCT LT 75 - - -)				LT20	G/CC	G/CC		PCT	PCT	PCT	CM	PCT	PCT		
000-9	TR	0	0	TR	TR	90	TR	1.00C					18.6				4.8	4.7
009-19	TR	0	0	0	TR	88	TR	1.20C					10.7				4.3	4.1
019-38	TR	0	0	0	TR	91	TR	1.34	1.42	.020	27.6	25.6	9.5	.22			4.5	4.1
038-56	TR	0	0	TR	TR	94	TR	1.32	1.46	.035	28.6	26.2	11.4	.20			4.6	4.1
056-78	TR	0	0	TR	TR	80	TR	1.36	1.56	.048	27.1	25.4	12.0	.19			4.5	4.1
078-101	1	0	TR	1	1	44	2	1.60C					7.2				4.7	4.2
101-135	2	0	TR	1	3	41	4	1.85	1.94	.015	13.3	12.3	6.3	.11			5.0	4.5
135-170	2	0	TR	1	3	40	4	1.85	1.98	.022	14.1	13.0	6.6	.11			5.4	4.9
170-205		0	TR	2	3	40	5						6.5				5.6	5.2
205-265		0	TR	5	8	19	13						4.5				6.2	5.6
265-315		0	0	1	3	25	4						4.0				6.3	5.7
315-375		0	0	TR	TR	44	TR						4.1				6.4	5.7
375-435		0	TR	2	5	13	7						3.4				6.2	5.5
000-38		0	0	0	TR	91	TR						12.1				4.8	4.8

DEPTH	(ORGANIC MATTER		)	IRON	PHOS	(- -EXTRACTABLE BASES 5B4A- -)					ACTY	AL	(CAT EXCH)		RATIO	RATIO	CA	(BASE SAT)	
	6A1A	6B1A	C/N	6C2B		6N2E	6O2D	6P2B	6Q2B		6H1A	6G1E	5A3A	5A6A	8D1	8D3	5F1	5C3	5C1
	ORGN	NITG		EXT	TCTL	CA	MG	NA	K	SUM	BACL	KCL	EXTB	NHAC	NHAC	CA	SAT	EXTB	NHAC
	CARB			FE						EXTB	TEA	EXT	ACTY		TO	TO	NHAC	ACTY	
CM	PCT	PCT		PCT	PCT	(- - -MEQ / 100 G- - -)									CLAY	MG	PCT	PCT	PCT
000-9	5.85D	.496	12	0.9		14.3	5.6	0.1	0.7	20.7	23.2	0.2	43.9	32.4	1.22	2.6	44	47	63
009-19	1.79	.156	11	0.9		3.0	2.4	0.1	0.3	5.8	16.1	3.1	21.9	17.4	0.81	1.3	17	26	33
019-38	0.63	.076	8	1.0		3.4	2.4	0.2	0.2	6.2	12.4	3.0	18.6	14.7	0.66	1.4	23	33	42
038-56	0.52	.059	9	1.1		6.1	4.2	0.2	0.4	10.9	11.1	2.3	22.	18.4	0.72	1.5	33	50	59
056-78	0.41	.036	11	1.0		7.4	5.4	0.2	0.4	13.4	10.8	2.9	24.2	20.5	0.73	1.4	36	55	65
078-101	0.22			0.7		5.1	3.7	0.2	0.2	9.2	5.4	1.2	14.6	12.6	0.66	1.4	40	63	73
101-135	0.18			1.3		5.3	3.4	0.2	0.2	9.1	3.3	0.4	12.4	10.3	0.59	1.6	51	73	88
135-170	0.11			0.8		6.2	4.2	0.3	0.3	11.0	2.7	0.2	13.7	11.3	0.62	1.5	55	80	97
170-205	0.11			0.6		6.2	4.2	0.4	0.3	11.1	1.5		12.6	11.0	0.64	1.5	56	88	101
205-265	0.08			1.1		4.4	2.6	0.2	0.2	7.4	1.5		8.9	7.7	0.74	1.7	57	83	96
265-315	0.08			2.1		3.8	2.0	0.2	0.2	6.2	1.5		7.7	6.3	0.69	1.9	60	81	98
315-375	0.11			1.2		4.4	2.3	0.2	0.2	7.1	1.2		8.3	7.1	0.73	1.9	62	86	100
375-435	0.10			1.1		3.6	1.6	0.2	0.2	5.6	1.6		7.2	5.6	0.85	2.3	64	78	100
000-38	4.03			0.9		12.2	3.5	0.1	0.4	16.2	16.9	0.2	33.1	23.4	1.13	3.5	52	49	69

DEPTH	(SATURATED PASTE)			NA	NA	SALT	GYP	(- - - SATURATION EXTRACT 8A1- - -)										ATTERBERG	
	8E1	8C1B	8A	5D2	5E	8D5	6F1A	8A1A	6N1B	6O1B	6P1B	6Q1B	6I1A	6J1A	6K1A	6L1A	6M1A	4F1	4F2
	REST	PH	H2O	ESP	SAR	TOTL		EC	CA	MG	NA	K	CO3	HCO3	CL	SO4	NO3	LQID	PLST
	OHM-					SOLU		MMHOS/										LMIT	INDX
CM	CM		PCT	PCT		PPM	PCT	CM	(- - - MEQ / LITER - - -)									PCT	
000-9																		56E	13
009-19																			
019-38																			
038-56																			
056-78																		39E	20
078-101	6400	4.4	28.4	2	1	20		0.16	0.4	0.3	0.3	0.1							
101-135																			
135-170																			
170-205																			
205-265																			
265-315																			
315-375																			
375-435																			
000-38																			

ANALYSES BY MINNESOTA AGRICULTURAL EXPERIMENT STATION, ST PAUL, MN. MINERALOGY, X-RAY ANALYSIS. TOTAL PHOSPHORUS, NITRIC-PERCHLORIC DIGESTION. AVAILABLE PHOSPHORUS, BRAY'S NO 1 EXTRACTANT.

DEPTH	(- - -MINERALOGY- - -)					TOTAL	AVAIL
	MONT	VERM	ILLITE	KAOL	QUARTZ	P	P
CM	(- - -PCT LT .002 MM- - -)					(- -LBS/A- -)	
000-9	30	20	35	10	5	1954	36
009-19	35	25	30	5	5		19
019-38	35	20	35	5	5	722	19
038-56	35	20	35	5	5		18
056-78	50	20	25	5	0	666	9
078-101	45	20	25	10	0		5
101-135	45	25	15	15	0		8
135-170	40	25	25	10	0	440	17
170-205	45	20	30	5	0		12
205-265	50	20	25	5	0	666	13
265-315	50	20	25	5	0		12
315-375	40	20	35	5	0		16
375-435	50	20	25	5	0		14

(A) COMPOSITE OF SEVERAL SURFACE SAMPLES IN VICINITY OF SAMPLING PIT.
(B) SAMPLED IN SOYBEAN FIELD 80 M SOUTH OF S70MN-50-1.
(C) ESTIMATED.
(D) ORGANIC CARBON IS 12 KG/M SQ TO A DEPTH OF 1 M (6A).
(E) DETERMINED BY SOIL MECHANICS LAB - SCS, LINCOLN, NE.

Pedon classification: Aeric Glossaqualf; fine-loamy, mixed, mesic.
Series classification; Typic Glossaqualfs; fine-loamy, mixed, mesic.
Soil: Sargeant taxadjunct*.
Soil No.: S70MN-50-1.
Location: Mower County, Minnesota; about 1/2 mile west of Brownsdale; about 40 feet west, and 90 feet north of southeast corner of SW1/4, NW1/4, Sec. 9, T. 103 N., R. 17 W.; about 92 deg. 53 min. west longitude and 43 deg. 44 min. north latitude.
Climate: Humid continental. Some features of precipitation in inches: annual normal - 30, May through September - 19, annual normal snowfall - 40. Some features of temperature in deg. F.: annual normal - 45, summer normal - 70, winter normal - 17.
Parent material: Loamy mantle (loess?) over loamy Kansan(?) till with intervening stone line; weathered outwash under the till.
Physiography: Central Lowlands; Iowan Erosion Surface (Ruhe); Rochester Till Plain (Wright); Claremont-Lyle Plain, silty, level (MN Soil Atlas).
Landscape setting: Site has a plane 1/2 percent slope. Topography in immediate area is mostly nearly level and gently sloping, and relative relief is about 10 feet. Elevation is about 1,285 feet.
Vegetation: Mixed oak forestry with red oak dominant. Native vegetation was probably savanna.
Drainage: Poorly drained.
Erosion: None.
Moisture: Moist throughout.
Permeability: Moderately slow or slow.
Described by: J. F. Cummins on October 21, 1970.
Sampled by: R. B. Grossman, E. R. Gross, R. H. Rust, J. F. Cummins, and H. R. Finney on October 21, 1970.

A1 70L1109 0 to 9 cm (0 to 3½ inches) Black (10YR 2/1) silt loam, very dark gray (10YR 3/1) rubbed; weak fine granular structure; friable; abrupt smooth boundary.

A21 70L1110 9 to 19 cm (3½ to 7½ inches) Dark grayish brown (2.5Y 4/2) silt loam, light brownish gray (2.5Y 6/2) dry; few fine faint dark gray (10YR 4/1) and common fine distinct dark brown (10YR 4/3) mottles; moderate thin platy structure; friable; few black (10YR 2/1) wormcasts; abrupt smooth boundary.

A22 70L1111 19 to 38 cm (7½ to 15 inches) Grayish brown (2.5Y 5/2) silt loam, light gray

Pedon classification: Aeric Glossaqualf; fine-loamy, mixed, mesic.
Series classification: Typic Glossaqualfs; fine-loamy, mixed, mesic.
Soil: Sargeant taxadjunct*.
Soil No.: S70MN-50-1.
Location: Mower County, Minnesota; about 1/2 mile west of Brownsdale; about 40 feet west, and 90 feet north of southeast corner of SW1/4, NW1/4, Sec. 9, T. 102 N., R. 17 W.; about 92 deg 53 min. west longitude and 43 deg. 44 min. north latitude.
Climate: Humid continental. Some features of precipitation in inches: annual normal - 30, May through September - 19, annual normal snowfall - 40. Some features of temperature in deg. F.: annual normal - 45, summer normal - 70, winter normal - 17.
Parent material: Loamy mantle (loess?) over loamy Kansan (?) till with intervening stone line; weathered outwash under the till.
Physiography: Central lowlands; Iowan Erosion Surface (Ruhe); Rochester Till Plain (Wright); Claremont-Lyle Plain, silty level (MN Soil Atlas).
Landscape setting: Site has a plane 1/2 percent slope. Topography in immediate area is mostly nearly level and gently sloping, and relative relief is about 10 feet. Elevation is about 1,285 feet.
Vegetation: Mixed oak forestry with red oak dominant. Native vegetation was probably savanna.
Drainage: Poorly drained.
Erosion: None.
Moisture: Moist throughout.
Permeability: Moderately slow or slow.
Described by: J. F. Cummins on October 21, 1970
Sampled by: R. B. Grossman, E. R. Gross, R. H. Rust, J. F. Cummins, and H. R. Finney on October 21, 1970.

IIB22t 70L1116 135 to 170 cm (53 to 67 inches) Yellowish brown (10YR 5/6 and 5/8) sandy loam; strong coarse prismatic structure; very firm; many clay films in pores and a few thin clay films on ped faces; gray (10YR 6/1) thin ped coatings of clean sand and silt particles; about 4 percent coarse fragments; abrupt wavy boundary.

IIB3 70L1117 170 to 205 cm (67 to 80 inches) (Auger sample) Yellowish brown (10YR 5/6 and 5/8) sandy loam; friable; abrupt boundary.

IIIC1 70L1118 205 to 265 cm (80 to 104 inches) (Auger sample) Yellowish brown (10YR 5/6) coarse loamy sand; abrupt boundary.

IIIC2 70L1119 265 to 315 cm (104 to 124 inches) (Auger sample) Yellowish brown (10YR 5/8) layered silt loam and coarse sand; abrupt boundary.

IIIC3 70L1120 315 to 375 cm (124 to 147 inches) (Auger sample) Layered yellowish brown (10YR 5/4) fine sandy loam and yellowish brown (10YR 5/8) coarse sand; abrupt boundary.

IIIC4 70L1121 375 to 435 cm (147 to 171 inches) (Auger sample) Light olive brown (2.5Y 5/4) layers of medium, coarse and very coarse sand.

*This pedon is outside the range of the Sargeant series because it lacks a calcareous loam IIC horizon beginning within depths of 84 inches.

Remarks: The samples were collected from a pit that was dug with a backhoe. Sample 70L1122, 0 to 38 cm, is a composite of several surface samples in the immediate vicinity of the sampling site. Pedon S70Minn-50-2 is located about 80 m south of S70Minn-50-1 in a soybean field. Samples of the 0 to 18 cm, 70L1123, and 18 to 32 cm, 70L1124, layers were collected from it. The Ap, 0 to 18 cm was a dark grey (10YR 4/1) silt loam with inclusions of grayish brown (10YR 5/2) and it had weak fine granular structure and friable consistence.

SOIL CLASSIFICATION Udic Haploboroll; coarse-loamy, mixed

SOIL Series not designated LOCATION Stevens County, Minnesota

SOIL NOS. S57MN-75-3 LAB. NOS. 6100-6105

SOIL SURVEY LABORATORY Lincoln, Nebraska DATE September 3, 1957

GENERAL METHODS 1A, 1B1a, 2A1, 2B

DEPTH INCHES	HORIZON	PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1									2A2	TEXTURAL CLASS
		VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	> 2	
0-7	Ap	2.9a	8.1	8.8	17.0	13.2	32.2	17.8	41.9	13.7	1	l
7-14	B2	2.4a	5.6	7.1	18.4	17.7	33.6	15.2	51.4	11.9	2	l
14-24	Cca	7.4b	7.1	7.1	16.6	13.2	36.0	12.6	42.6	17.0	10	l
24-35	C1	7.2b	7.6	8.7	23.7	15.1	27.0	10.7	44.3	12.4	11	fsl
35-48		0.1b	2.6	7.2	18.2	17.3	39.6	15.0	52.7	16.0	-	l
48-60		4.7b	6.4	8.0	22.2	16.1	30.5	12.1	48.3	11.9	6	fsl

	pH 8C1a		ORGANIC MATTER				ELECTRICAL CONDUCTIVITY EC x 10³ MILLIMHOS PER CM 8A1a	6E1a		MOISTURE TENSIONS		
SATURATED PASTE	1:5	1:10	6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	EST% SALT (BUREAU CUP)		$CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
7.6	7.8	7.8	2.04	0.182	11		0.5	-				
7.7	8.0	8.0	0.83	0.087	10		0.5	-				
8.1	8.6	8.9	0.35	0.048	7		0.5	28				
8.1	8.8	9.1	0.17		9		0.6	22				
8.2	8.9	9.0	0.11				0.6	22				
8.2	8.8	9.0	0.08				0.6	17				

5A1a	EXTRACTABLE CATIONS 5B1a						SATURATION EXTRACT SOLUBLE 8A1					8A
CATION EXCHANGE CAPACITY NH_4Ac	6N2b Ca	6O2b Mg	H	6P2a Na	6Q2a K	Base Sat.	6P1a Na	6Q1a K	6N1a Ca	6O1a Mg		MOISTURE AT SATURATION
← milliequivalents per 100g. soil →						%	← milliequivalents per liter →					%
18.5	18.0	3.4		-	0.3		0.3	0.1	3.4	1.4		40.3
13.1	11.2	3.2		0.1	0.1		0.4	0.1	2.4	1.6		38.2
6.1				-	0.1		0.5	0.1	2.4	1.7		30.0
5.7				0.1	0.1		0.7	0.1	2.6	1.9		26.6
7.6				0.1	0.1		0.7	-	2.3	2.2		33.3
5.8				0.1	0.1		0.8	-	2.0	3.2		28.4

a. Few black irregular concretions in sand fraction (Mn?).

b. Few $CaCO_3$ concretions in sand fraction; few black irregular concretions in sand fraction (Mn?).

Soil classification: Udic Haploboroll; coarse-loamy, mixed.
Soil: Series not designated.
Soil Nos.: S57MN-75-3.
Location: SE of NW 1/4 Sec. 23, T125N, R41W, Stevens County, Minnesota.
Topography: Gently rolling ground moraine. Sample taken on 3-percent slope facing to the northwest.
Drainage and permeability: Well drained, runoff is medium. Permeability is moderately rapid in B horizon and rapid in that part of the C horizon which is sandy.
Present cover: Cultivated.

Collected by: L. T. Alexander, J. S. Allen, R. F. Dever, and A. S. Robertson, August 11, 1957.
Described by: A. S. Robertson.

Ap 6100 0 to 7 inches Black (10YR 2/1) moist loam; friable; cloddy structure; lower boundary is abrupt and smooth.

B2 6101 7 to 14 inches Dark brown (10YR 3/3 to 4/3) moist, loam; friable; weak coarse and medium prisms; (no secondary structure was noted but may have been present), some very thin patchy clay skins on faces of prisms; lower boundary was clear and smooth. A few small vertical channels, 2 to 5 mm in diameter, filled with limy material from the Cca horizon were present.

Cca 6102 14 to 24 inches Yellowish brown (10YR 5/4) moist, loam; very friable; lime disseminated throughout the mass; violent reaction to HCl.

C1 6103 24 to 35 inches Yellowish brown to light olive brown (10YR 5/4 to 2.5Y 5/6) moist, sandy loam; very friable; reacts violently with HCl. Lower boundary is clear and wavy.

6104 35 to 48 inches Light olive brown (2.5Y 5/4 to 5/6) moist, loam; common small distinct yellowish brown and light brownish gray mottles; massive; very friable; reacts violently with HCl. Lower boundary is clear and wavy.

6105 48 to 60 inches Uniformly mixed light olive brown (2.5Y 5/4) and (2.5Y 5/6) moist, fine sandy loam; very friable; single grain structure with some coherence. This material appears to have very thin layers of fine sands, very fine sands and silts.

Remarks: A few granitic stones and a few pebbles of dolomite occurred in the lower part of the B2 and upper part of

SOIL CLASSIFICATION Typic Haplaquept; fine-loamy, mixed, frigid

SOIL Series not designated — LOCATION Koochiching County, Minnesota

SOIL NOS. S58MN-36-3 — LAB. NOS. 9107-9112, 9125

SOIL SURVEY LABORATORY Lincoln, Nebraska — DATE May 1959

GENERAL METHODS 1A, 1B1a, 2A1, 2B

DEPTH INCHES	HORIZON	PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2	TEXTURAL CLASS
0-4	A1	1.3a	2.7a	2.4a	3.3b	2.5b	35.3	52.5	11.1	28.5	-	c
4-8	C1g	5.1c	7.2c	7.6c	9.3c	5.1c	24.9	40.8	18.1	16.3	7	c
8-16	C2g	1.4d	2.8d	3.4d	9.1d	7.1d	24.7	51.5	19.8	17.5	2	c
16-26	C3g	2.2d	3.9d	4.1d	10.1d	8.3d	36.5	34.9	25.9	25.0	1	cl
26-36	C4g	2.8d	4.4d	4.7d	15.1d	11.6d	35.5	25.9	34.9	21.1	4	l
36-44	C5	2.9d	3.4d	4.0d	11.9d	9.0d	36.1	32.7	29.8	22.5	6	cl
0-6	e											

DEPTH INCHES	pH 8C1a 1:1	1:5	1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	6C1a Free Iron Fe_2O_3 %	ELECTRICAL CONDUCTIVITY EC x 10^3 MILLIMHOS PER CM	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
0-4	7.3			10.28	0.755	14	1.0		Δ				29.9
4-8	7.3			0.87	0.096	9	0.8		Δ				13.8
8-16	7.6			0.35	0.036	10	0.6		Δ				16.8
16-26	8.0			0.18	0.020		0.6		16				12.7
26-36	8.3			0.14			0.6		23				9.3
36-44	8.3			0.20			0.6		27				11.0
0-6				7.40e	0.423e	18e							

5A1a EXTRACTABLE CATIONS 5B1a 5C1 5C3 5B1a 5A3a 8D3

Soil classification: Typic Haplaquept; fine-loamy, mixed, frigid.
Soil: Series not designated.
Soil Nos.: S58MN-36-3.
Location: SE NE NE 1/4 Sec. 14, T68N, R23W, Koochiching County, Minnesota. Sample collected in wooded area adjacent to a cultivated field.
Vegetation: Aspen and alder.
Parent material: Clay loam till (lacustrine clays reworked by glacier).
Topography: Nearly level; slopes are less than 1 percent.
Drainage: Poor.
Permeability: Slow.
Ground water: At about 16 inches.
Stoniness: There was an occasional stone in the pedon.
Collected by: A. H. Paschall, M. Scilley, and J. K. Ableiter.
Described by: A. H. Paschall.

Ao 2 to 0 inch. Black (5Y 2/1 to 2/2) mat of organic material. Contains some woody material.

A1 9107 0 to 4 inches Black (10YR 2/1) silty clay loam; moderate very fine subangular blocks; friable when moist; plastic when wet; contains many roots and a few pebbles; pH 7.5; clear wavy boundary, 2 to 4 inches thick.

C1g 9108 4 to 8 inches Olive gray (5Y 5/2) heavy clay loam; moderate very fine angular blocks; plastic and sticky when wet; roots plentiful; some small pebbles; some peds have surface coatings of dark gray (5Y 4/1); pH 7.5; gradual wavy boundary.

C2g 9109 8 to 16 inches Gray (5Y 5/1) to olive gray (5Y 5/2) silty clay; moderate very fine angular blocky structure; plastic when wet; roots plentiful; pH 7.5; gradual wavy boundary.

C3g 9110 16 to 26 inches Light olive gray (5Y 6/2) to olive gray (5Y 5/2) clay loam; moderate very fine angular blocky structure; plastic when wet; many small faint mottlings of yellowish brown (10YR 5/4) and olive (5Y 5/3); few roots; many small pebbles; pH 7.5; gradual wavy boundary.

C4g 9111 26 to 36 inches Light olive gray (5Y 6/2) to olive gray (5Y 5/2) clay loam; weak very fine angular blocky structure; plastic when wet; many medium distinct mottles of yellowish brown (10YR 5/4); few roots; pH 7.5;

gradual wavy boundary.

C5 9112 36 to 44 inches Light olive gray (5Y 6/2) to olive gray (5Y 5/2) clay loam; massive; plastic when wet; effervesces with acid.

Remarks: All colors are for moist soils unless otherwise noted.
A sample (LSL 9125) was taken from a cultivated field near the site for determination of organic carbon and nitrogen. Location 0.2 mile north of the southeast corner, Sec. 14, T68N, R23W.

SOIL CLASSIFICATION Mollic Haplaquept; coarse-loamy, mixed, frigid

SOIL Series not designated LOCATION Wadena County, Minnesota

SOIL NOS. S58MN-80-1 LAB. NOS. 9113-9117, 9128

SOIL SURVEY LABORATORY Lincoln, Nebraska DATE May 1959

GENERAL METHODS 1A, 1B1a, 2A1, 2B

		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)									3A1 2A2	
DEPTH INCHES	HORIZON	VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	> 2	TEXTURAL CLASS
0-6	A1	2.5	10.2	10.4	14.8	6.2	40.9	15.0	29.3	24.4	-	l
6-12	C1g	4.2	13.8	13.6	19.3	7.2	34.5	7.4	31.2	18.9	9	sl
12-23	C2g	6.4	11.9	11.4	17.3	6.7	26.7	19.6	26.9	14.1	9	sl
23-36	C3g	5.8	13.3	13.7	23.6	8.8	19.3	15.5	28.6	10.4	6	sl
36-44	C	7.2a	16.0a	14.5a	21.9a	8.3a	20.7	11.4	27.5	11.2	5	sl
0-7	b											

	pH		ORGANIC MATTER			6C1a	ELECTRICAL CONDUCTIVITY	6E1a		MOISTURE TENSIONS		
8C1a			6A1a	6B1a		Free Iron	EC x10³					4B2
1:1	1:5	1:10	ORGANIC CARBON %	NITROGEN %	C/N	Fe_2O_3 %	MILLIMHOS PER CM	$CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
6.4			4.28	0.322	13	0.6						11.5
7.6			0.16	0.021	8	0.5		<1				2.5
7.3			0.13	0.019	7	1.0		<1				8.2
7.6			0.06	0.012	5	0.7		1				5.8
8.2			0.04			0.5		2				4.0
			3.66b	0.029b	13b							

5A1a	EXTRACTABLE CATIONS				5B1a	5C1	5C3	5B1a	5A3a	8D3		
CATION EXCHANGE CAPACITY NH_4Ac	6N2b Ca	6O2b Mg	6H1a H	6P2a Na	6Q2a K	Base Sat. % NH_4Ac Exch.	Base Sat. % on Sum Cations	Sum Bases	Sum Cations	Ca/Mg		MOISTURE AT SATURATION
←	milliequivalents per 100g. soil →							me/100g				%
22.3	18.9	3.2	7.7	<0.1	0.2	100	74	22.3	30.0	5.9		
5.0	4.5	0.8	0.8	<0.1	<0.1	106	87	5.3	6.1	5.6		
13.8	12.4	2.3	2.0	<0.1	0.2	108	88	14.9	16.9	5.4		
10.7	9.7	2.3	1.2	<0.1	0.1	113	91	12.1	13.3	4.2		
7.2		1.6	<0.1	<0.1	0.1							

a. Common $CaCO_3$ concretions.

b. Sample from cultivated field 300 yards west of site, 0 to 7 inches, LSL 9128.

Soil classification: Mollic Haplaquept; coarse-loamy, mixed, frigid.
Soil: Series not designated.
Soil Nos.: S58MN-80-1.
Location: Sec. 8, T135N, R35W, Wadena County, Minnesota. Site is 100 yards west of road and 0.6 mile north of south boundary of section (near Air Force Base).
Vegetation: Willow, elm, and sedge.
Parent material: About 3 feet of alluvial deposition over sandy loam till.
Physiography: Site occupies a shallow, concave depression.
Slope: Less than 1 percent.
Drainage: Poor to very poor.
Permeability: Moderate.
Ground water: Occurs at 36 inches.
Stoniness: There are a few stones and boulders on the surface and in the pedon.
Collected by: A. H. Paschall.
Described by: A. H. Paschall.

A1 9113 0 to 6 inches Black (10YR 2/1) silty clay loam to clay loam; moderate very fine subangular blocky structure; friable when moist; roots plentiful; pH 7.5 plus; gradual wavy boundary.

Clw 9114 6 to 12 inches Gray (2.5Y 6/1) to grayish brown (2.5Y 5/2) sandy loam or light clay loam; weak fine

SOIL CLASSIFICATION Mollic Haplaquept; coarse-loamy, mixed, frigid

SOIL Series not designated — LOCATION Wadena County, Minnesota

SOIL NOS. S58MN-80-3 — LAB. NOS. 9118-9123, 9129

SOIL SURVEY LABORATORY Lincoln, Nebraska — DATE May 1959

GENERAL METHODS 1A, 1B1a, 2A1, 2B

DEPTH INCHES	HORIZON	PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2	TEXTURAL CLASS
0-5	A1	4.9	10.2	7.9	9.8	3.8	28.4	35.0	18.1	18.2	tr	cl
5-16	A12	4.8	14.8	13.7	16.0	6.4	26.5	17.8	25.3	15.8	8	sl
16-21	C1g	6.5	11.9	11.2	14.8	6.4	29.2	20.0	27.9	15.3	9	l
21-33	C2g	7.2	12.2	11.9	15.6	6.7	30.8	15.6	30.7	14.9	14	sl
33-48	C3g	7.3	13.8	18.0	24.9	10.0	15.9	10.1	32.7	5.9	13	sl
48-54	C4	11.0a	16.1a	16.7a	21.0a	8.3a	18.6	8.3	29.8	7.6	10	cosl
0-8	b											

DEPTH INCHES	pH 8C1a 1:1	1:5	1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	6C1a Free Iron Fe_2O_3 %	ELECTRICAL CONDUCTIVITY EC x 10^3 MILLIMHOS PER CM	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
0-5	5.5			6.77	0.522	13	1.6						21.4
5-16	5.8			0.76	0.063	12	1.3						8.6
16-21	5.9			0.30	0.032	9	1.0						9.0
21-33	6.5			0.19	0.022		0.6		<1				6.9
33-48	7.9			0.08			1.0		1				3.7
48-54	8.3			0.03			0.6		6				3.1
0-8				4.80b	0.322b	15b							

DEPTH INCHES	5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	6Q2a K	5B1a 5C1 Base Sat. % NH_4Ac Exch.	5C3 Base Sat. % on Sum Cations	5B1a Sum Bases	5A3a Sum Cations	8D3 Ca/Mg	MOISTURE AT SATURATION %
	←	milliequivalents per 100g. soil				→			me/100g			
0-5	43.5	30.6	6.8	21.9	0.1	0.4	87	63	37.9	59.8	4.5	
5-16	18.8	12.6	5.0	6.5	0.1	0.2	95	73	17.9	24.4	2.5	
16-21	18.8	12.3	6.3	4.1	0.1	0.2	100	82	18.9	23.0	2.0	
21-33	13.6	8.9	5.3	1.6	0.1	0.2	107	90	14.5	16.1	1.7	
33-48	7.2	5.9	3.2	0.8	<0.1	0.1	128	92	9.2	10.0	1.8	
48-54	5.5		2.1	<0.1	<0.1	0.1						
0-8												

a. Common $CaCO_3$ concretions.

b. Sample from cultivated field near site, 0 to 8 inches, LSL 9129.

Soil classification: Mollic Haplaquept; coarse-loamy, mixed, frigid.
Soil: Series not designated.
Soil Nos.: S58MN-80-3.
Location: NW 1/4 Sec. 30, T136N, R35W, Wadena County, Minnesota. Site is located 100 yards west of road through section and 50 yards south of road on north boundary of section. The sample was collected in a wooded area that has been pastured.
Vegetation: Alder, dogwood, and aspen. There was a cover of clover on the ground.
Parent material: Alluvial deposits on sandy loam till.
Physiography: The soil occupies a shallow concave depression; the low part of the depression is a peat bog.
Slope: Less than 1 percent.
Drainage: Poor to very poor.
Permeability: Moderate.
Ground water: Occurred at about 42 inches.
Stoniness: A few stones and boulders occur on the surface and in the pedon.
Collected by: A. H. Paschall.
Described by: A. H. Paschall.

A1 9118 0 to 5 inches Black (10YR 2/1) silty clay loam; moderate very fine subangular blocky structure; friable when moist; roots plentiful; pH 6.0; clear wavy boundary, 3 to 8 inches in thickness.

A12 9119 5 to 16 inches Very dark gray (10YR 3/1) to dark gray (10YR 4/1) silty clay loam; weak very fine subangular blocky structure; friable when moist, slightly plastic when wet; roots plentiful; few pebbles, pH 6.0; clear wavy boundary, 3 to 12 inches thick.

C1g 9120 16 to 21 inches Dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) (about 60-40 mixture in color) clay loam; moderate fine angular blocky structure; slightly plastic when wet; roots few; pH 6.0; clear wavy boundary.

C2g 9121 21 to 33 inches Grayish brown (2.5Y 5/2) clay loam; weak fine subangular blocky structure; slightly plastic when wet; common medium distinct dark brown (7.5YR 4/4) mottles; occasional dark gray (10YR 3/1) coatings on some ped faces; roots few; pH 6.0; clear wavy boundary.

C3g 9122 33 to 48 inches Grayish brown (2.5Y 5/2) sandy loam; massive; friable when moist; very slightly plastic when wet; many large distinct dark brown (7.5YR 4/4) mottles; clear wavy boundary.

C4 9123 48 to 54 inches Grayish brown (2.5Y 5/2) sandy loam; massive; friable; few small distinct dark brown (7.5YR 4/4) mottles; weak effervescence with acid.

Remarks: All colors are for moist soils unless otherwise noted.

A sample (LSL 9129) was taken from a cultivated field near the site for determination of organic carbon and nitrogen. Location 100 yards east of corner and 50 yards north of south boundary road SW SE 1/4 Sec. 30, T136N, R35W.

SOIL CLASSIFICATION-AERIC CALCIAQUOLL
COARSE-LOAMY OVER CLAYEY, FRIGID
SERIES - - - - - - -SERIES NOT DESIGNATED

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, MTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

SOIL NO - - - - - - 67MN-84-1 COUNTY - - - WILKIN

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 67L577-67L585 FEBRUARY 1977

PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B

DEPTH CM	HORIZON	SAND 2-.05 PCT	SILT .05-.002 PCT	CLAY LT .002 PCT	FINE CLAY LT .0002 PCT	VCOS SAND 2-1 PCT LT 2MM	CORS SAND 1-.5 PCT LT 2MM	MEDS SAND .5-.25 PCT LT 2MM	FNES SAND .25-.10 PCT LT 2MM	VFNS SAND .10-.05 PCT LT 2MM	COSI SILT .05-.02 PCT LT 2MM	FNSI SILT .02-.002 PCT LT 2MM	VFSI SILT .005-.002 PCT LT 2MM	FAML TEXT SAND 2-.1 PCT	INTR II .2-.02 CLAY PCT	FINE CLAY TO CLAY PCT	NON-CO3-CLAY PCT	8C1 15-BAR TC CLAY
COC-18	AP	78.5	8.9	12.6	6.C	.4	1.8	3.8	23.9	48.7	3.8	5.1		29.8	71.3	48	11	.49
C18-36	A12CA	75.6	9.C	15.4		.2	.8	2.0	22.0	50.7	4.3	4.7		24.9	73.6		9	.38
C36-48	C1CA	81.1	7.4	11.5		.2	.4	1.5	20.9	58.C	3.7	3.7		23.0	8C.1		8	.38
C48-66	C2	84.2	8.2	7.6		C	.2	1.0	15.0	68.C	4.C	4.2		16.2	85.7		7	.36
C66-81	C3	9C.7	5.7	3.6		.2	.4	.5	17.2	72.4	3.3	2.4		18.3	92.5		4	.42
C81-91	C4	84.9	10.4	4.7		1.1	1.5	.6	11.3	7C.4	5.4	5.0		14.5	86.7		5	.47
091-107	2C5	5.0	37.2	57.8		.1	.4	.4	1.1	3.C	1.1	36.0		2.0	4.9		56	.38
107-127	2C6	2.3	56.8	4C.9		.2	.3	.3	.8	.7	.8	56.C		1.6	2.0		39	.44
127-152	2C7	1.9	38.C	6C.1	18.1	.2	.2	.2	.6	.7	.3	37.7	22.4	1.2	1.3	30	58	.40

DEPTH CM	VCL. GT 2 MM PCT	GT 75 MM PCT	WEIGHT 75-20 MM PCT LT 75	WEIGHT 20-5 MM PCT LT 75	WEIGHT 5-2 MM PCT LT 75	4A1D LT .C74 MM PCT LT20	4A1H 20-2 MM PCT LT20	BULK DENSITY 1/3-BAR OVEN DRY G/CC	4D1 COLE G/CC	4B1C 1/10 BAR PCT	WATER CONTENT 4B1C 1/3-BAR PCT	4B2 15-BAR PCT	4C1 WRD CM/CM	CARBONATE 6E1B LT 2 MM PCT	3A1A LT .002 MM PCT	PH 8C1A 1/1 H2O	PH 8C1E 1/2 CACL
COC-18	TR	C	0	0	TR	32	TR	1.49	1.55	.013		20.7	6.2	.22	6	2	8.0	
018-36	TR	0	0	TR	TR	35	TR	1.54	1.56	.004		17.2	5.8	.18	11	6	8.5	
C36-48	TR	0	0	C	TR	29	TR	1.60A					4.4		12	4	8.5	
C48-66	TR	0	0	C	TR	3C	TR	1.60B	1.62	.004	17.9		2.7	.24	13	1	8.5	
C66-81	TR	C	0	C	TR	26	TR	1.60A					1.5		1C	TR	8.2	
C81-91	TR	C	0	TR	TR	34	TR	1.56B	1.55	.001	21.7		2.2	.3C	12	TR	8.2	
C91-1C7	TR	C	0	TR	TR	9E	TR	1.24	1.47	.058		36.4	22.1	.18	14	2	7.9	
1C7-127	TR	C	C	C	TR	98	TR	1.20A					18.0		17	2	8.C	
127-152	TR	0	0	0	TR	9S	TR	1.3C	1.42	.030		36.1	24.0	.16	13	2	7.8	

DEPTH CM	ORGANIC MATTER 6A1A ORGN CARB PCT	6B1A NITG PCT	C/N	IRON 6C2A EXT FE PCT	PHOS 6S1A TOTL PCT	EXTRACTABLE BASES 5B4A- -) 6N2E CA MEQ/100 G	6O4C MG	6P2A NA	6Q2A K	SUM EXTB	ACTY 6H1A BACL TEA	AL 6G1C KCL EXT ACTY	(CAT EXCH) 5A3A EXTB NHAC	5A6A NHAC TC CLAY	RATIO 8D2 NHAC CA TO CLAY	RATIO 8D3 CA TO MG	CA 5F SAT NHAC ACTY PCT	(BASE SAT) 5C3 EXTB ACTY PCT	5C1 NHAC PCT
COC-18	1.33C	.127	10			3.4	.2	.3						1C.7	.97				
C18-36	.43	.C42	1C			5.4	.3	.2						6.4	.71				
C36-48	.19	.C22	9			5.2	.4	.2						5.2	.65				
C48-66	.11					4.3	.8	.2						3.4	.49				
C66-81	.06					6.5	1.8	.1						2.5	.63				
C81-91	.07					7.8	2.2	.1						3.3	.66				
C91-1C7	.3C					28.1	6.5	1.2						28.7	.91				
107-127	.1S																		
127-152	.19					3C.1	7.0	1.2						28.9	.5C				

DEPTH CM	(SATURATED PASTE) 8E1 REST CHM-	8C1B PH	8A H2O PCT	NA 5D2 FSP PCT	NA 5E SAR	SALT 8D5 TOTL SOLL PPM	GYP 6F1A PCT	SATURATION EXTRACT 8A1- 8A1A EC MMHOS/CM	6N1B CA	6O1B MG	6P1A NA	6Q1A K	6I1A CO3	6J1A HCO3	6K1A CL	6L1A SO4	6M1A NO3	ATTERBERG 4F1 LQID LMIT PCT	4F2 PLST INDX
									MEQ / LITER										
COC-18	19CC	7.4	32.6			3EC		1.80											
C18-36																			
C36-48																			
C48-66																			
C66-81																			
C81-91	37C	8.2	24.0	30		24CC		2.6C			51.7								
C91-107	27C	7.9	85.2	11		5ECC		8.42			37.5								
107-127																			
127-152																			

CLAY MINERALOGY (7A2C).
CCC-18 MT1 MI1 KK1.
127-152 MT4 MI3 KK3.
COMMENTS - CLAYS IN A1P POORLY ORDERED, BY INFERENCE CONTAIN CONSIDERABLE AMORPHOUS MATERIAL. CLAYS OF THE 2C7 ARE WELL ORDERED.
RELATIVE AMOUNTS - (X-RAY) 5 = DOMINANT 4 = ABUNDANT 3 = MODERATE 2 = SMALL 1 = TRACE.
MINERAL CODE - MT = MONTMORILLONITE MI = MICA KK = KAOLINITE
(A) ESTIMATED.
(B) 1/10-BAR, METHOD 4A1G.
(C) 6 KG OF CARBON PER SQ METER TO A DEPTH OF 1 METER, METHOD 6A.

Soil classification: Aeric Calciaquoll; coarse-loamy over clayey, frigid.
Series: Not designated.
Pedon No.: S67MN-84-1.
Area: Wilkin County, Minnesota.
Location: NE¼NE¼ sec. 19, T. 132 N., R. 45 W. (Foxhome Twp.); 50 feet south and 350 feet west of the third powerline pole south of the northeast corner of section 19.
Climate: Some characteristics of temperature in degrees F. are: annual normal - 43, winter normal - 13, summer normal - 70; some characteristics of precipitation in inches are: mean annual - 21, May to September - 14, mean annual snowfall - 40.
Vegetation: Recently plowed field.
Parent material: Moderately shallow, calcareous, loamy and sandy glacio-lacustrine sediments over calcareous clayey lacustrine sediments.
Physiography: Lake Agassiz plain; sample site is located between the Campbell and the Tintah beaches.
Topography: Sample site occurs near crest of about a 10-acre elongated knoll. The side slopes are about 1 percent. This area slopes to the west at about 6 feet per mile.
Drainage: About somewhat poorly drained.
Erosion: None to slight, although farmer says there is a problem with blowing sand.
Permeability: Moderately rapid in the upper part, slow in the lower part.
Sampled by: R. H. Jordan, G. S. Holmgren, and H. R. Finney on October 18, 1967.
Described by: H. R. Finney.

Ap 67L577 0 to 18 cm (0 to 7 inches) Black (10YR 2/1) heavy fine sandy loam; weak medium subangular blocky structure parting to weak fine and very fine granular; very friable; roots plentiful; strongly effervescent; abrupt smooth boundary.

A12ca 67L578 18 to 36 cm (7 to 14 inches) Very dark gray (10YR 3/1) fine sandy loam; weak medium subangular blocky structure; very friable; few roots; violently effervescent; gradual smooth boundary.

C1ca 67L579 36 to 48 cm (14 to 19 inches) Dark gray (10YR 4/1) fine sandy loam; weak fine and medium subangular blocky structure; very friable; few roots; violently effervescent; clear wavy boundary.

SOIL CLASSIFICATION-TYPIC CALCIAQUOLL
COARSE-LOAMY OVER CLAYEY, FRIGID
SERIES - - - - - - -SERIES NOT DESIGNATED

SOIL NO - - - - - - S67MN-84-2 COUNTY - - - WILKIN

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 67L593-67L601

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, MTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

FEBRUARY 1977

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B - PCT LT 2MM														RATIO
					FINE	SAND					SILT			FAML	INTR	FINE	NON-	8D1
		SAND	SILT	CLAY	CLAY	VCOS	CORS	MEDS	FNES	VFNS	COSI	FNSI	VFSI	TEXT	II	CLAY	COS-	15-
		2-	.05-	.002	LT	2-	1-	.5-	.25-	.10-	.05	.02	.002-	SAND	.2-	TO	CLAY	BAR
CM		.05	.002	LT	.0002	1	.5	.25	.10	.05	.02	.002	.002	2-.1	.02	CLAY		TO
																	PCT	CLAY
COC-25	AP	77.5	11.5	11.0		.6	2.7	3.7	21.8	48.5	4.9	6.6		28.9	71.2		11	.65
C25-43	A3CA	75.2	10.2	14.6		.6	2.0	2.1	19.4	51.0	3.7	6.5		24.1	71.3		9	.44
C43-61	C1CCA	77.7	8.3	14.0		1.2	2.2	1.7	21.2	51.5	3.7	4.6		26.2	74.2		8	.39
C61-74	C2CCA	87.2	6.9	5.9		2.5	4.3	2.2	17.8	60.3	3.5	3.0		26.9	80.9		6	.44
C74-86	C3G	81.6	11.8	6.6		6.8	10.2	4.7	10.3	40.5	5.4	6.4		32.1	64.1		7	.36
C86-91	C4G	75.7	12.8	11.5		13.4	22.3	11.3	6.6	22.0	3.8	9.0		53.7	29.9		12	.34
C91-112	2C5G	4.4	53.2	42.4		.2	.7	.6	1.3	1.6	.4	52.8		2.8	2.8		38	.43
112-142	2C6G																	
142-165	2C7G	2.5	43.7	53.8		.2	.3	.3	.9	.7	.9	42.8		1.7	2.1		53	.40

DEPTH	(PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2) VOL. (- HEIGHT -)					BULK DENSITY					WATER CONTENT			CARBONATE		PH	
	GT 2	GT 75	75-20	20-5	5-2	LT .074	20-2	4A1D 1/3- BAR	4A1H OVEN DRY	4D1 COLE	4B1C 1/10 BAR	4B1C 1/3- BAR	4B2 15- BAR	4C1 WRD CM/	6E1B LT 2	3A1A LT .002	8C1A 1/1 H2O	8C1E 1/2 CACL
CM	PCT	PCT	PCT LT 75			LT20	G/CC	G/CC			PCT	PCT	PCT	CM	PCT	PCT		
COC-25	TR	C	C	C	TR	32	TR	1.51	1.56	.011		20.9	7.2	.19	3	TR	7.8	
C25-43	TR	C	C	C	TR	35	TR	1.50	1.53	.007		13.2	6.4	.10	11	6	8.0	
C43-61	TR	C	C	C	TR	31	TR	1.52	1.55	.007		13.5	5.4	.12	14	6	8.1	
C61-74	TR	C	C	C	TR	25	TR	1.60A					2.6		5	TR	8.5	
C74-86	1	C	C	C	2	32	2	1.65B	1.68	.006	13.9		2.4	.19	13	TR	8.3	
C86-91	1C	C	C	5	11	27	16	1.50A					4.6		15	TR	8.2	
C91-112	TR	C	C	C	TR	56	TR	1.28	1.42	.035		30.6	18.1	.16	19	4	8.1	
112-142	TR	C	C	C	TR		TR						18.9		18		7.9	
142-165	TR	C	C	TR	TR	98	TR	1.26	1.50	.060		37.3	21.4	.20	15	1	7.8	

DEPTH	(ORGANIC MATTER) 6A1A ORGN CARB	6B1A NITG	C/N	IRON 6C2A EXT FE	PHOS 6S1A TOTL	EXTRACTABLE BASES 5B4A- 6N2E CA	604C MG	6P2A NA	6Q2A K	SUM EXTB	ACTY 6H1A BACL TEA	AL 6G1C KCL EXT	(CAT EXCH) 5A3A EXTB ACTY	5A6A NHAC	RATIO 8D2 NHAC TO CLAY	RATIC 8D3 CA TO MG	CA SF SAT NHAC	(BASE SAT) 5C3 EXTB ACTY	5C1 NHAC
CM	PCT	PCT		PCT	PCT	MEQ / 100 G												PCT	PCT
COC-25	1.92C	.176	11				5.3	.8	.2					13.9	1.26				
C25-43	.64	.067	10				5.1	1.0	.1					6.7	.46				
C43-61	.37	.039	9				4.1	1.2	.1					5.0	.36				
C61-74	.11						3.6	1.4	.1					3.6	.61				
C74-86	.04						6.3	2.3	.1					4.3	.65				
C86-91	.07						7.9	2.2	.2					5.9	.51				
C91-112	.3C						25.3	6.2	.7					22.4	.53				
112-142	.23																		
142-165	.13						24.8	4.4	1.0					25.8	.48				

DEPTH	(SATURATED PASTE) 8E1 REST CHM-	8C1B PH	8A H2O	NA 5C2 ESP	NA 5E SAR	SALT 8C5 TOTL SOLU	GYP 6F1A	(- SATURATION EXTRACT 8A1- 8A1A EC	6N1B CA	6O1B MG	6P1A NA	6Q1A K	6I1A CO3	6J1A HCO3	6K1A CL	6L1A SO4	6M1A NO3	ATTERBERG 4F1 LQID LMIT	4F2 PLST INDX
CM	CM		PCT	PCT		PPM	PCT	MMHOS/CM	(MEQ / LITER)									PCT	
COC-25	78C	7.4	36.4			12CC	TR	4.59											
C25-43																			
C43-61																			
C61-74																			
C74-86																			
C86-91	54C	7.9	21.1	20		18CC		10.7			48.5								
C91-112	24C	8.0	68.3	14		54CC	2.0	10.1			44.3								
112-142																			
142-165																			

(A) ESTIMATED.
(B) 1/10-BAR, METHOD 4A1G.
(C) 11 KG OF CARBON PER SQ METER TO A DEPTH OF 1 METER, METHOD 6A.

Soil classification: Typic Calciaquoll; coarse-loamy over clayey,frigid
Series: Not designated.
Pedon No.: S67MN-84-2.
Area: Wilkin County, Minnesota.
Location: SE¼NE¼NE¼ sec. 19, T. 132 N., R. 45 W. (Foxhome Twp.); 180 feet south and 110 feet west of the third powerline pole south of northeast corner of section 19.
Climate: Some characteristics of temperature in degrees F. are: annual normal - 43, winter normal - 13, summer normal - 70; some characteristics of precipitation in inches are: mean annual - 21, May to September - 14, mean annual snowfall - 40.
Vegetation: Recently plowed field; native vegetation was species of the tall prairie plant formation.
Parent material: Moderately shallow, calcareous, loamy and sandy glacio-lacustrine sediments over calcareous, clayey, lacustrine sediments.
Physiography: Lake Agassiz plain.
Topography: Slope at site is level.
Drainage: Poorly drained.
Erosion: None.
Permeability: Moderate in upper part, slow in underlying material.
Sampled by: R. H. Jordan, G. S. Holmgren, R. A. Erickson, and H. R. Finney on October 19, 1967.
Described by: H. R. Finney.

Ap 67L593 0 to 25 cm (0 to 10 inches) Black (10YR 2/1) very fine sandy loam; weak fine subangular blocky structure parting to moderate fine and very fine granular structure; very friable; plentiful roots; strongly effervescent; abrupt smooth boundary.

A3ca 67L594 25 to 43 cm (10 to 17 inches) Mixed very dark gray (10YR 3/1) and dark gray (10YR 4/1) very fine sandy loam; very dark gray (10YR 3/1) rubbed; weak fine subangular blocky; very friable; few roots; about 2 percent soft white limy segregations 1.0 to 2.0 mm in diameter; strongly effervescent; gradual wavy boundary.

C1gca 67L595 43 to 61 cm (17 to 24 inches) Gray and grayish brown (2.5Y 5/1 and 2.5Y 6/1) very fine sandy loam; weak medium subangular blocky structure; very friable; few roots; violently effervescent; clear wavy boundary.

C2gca 67L596 61 to 74 cm (24 to 29 inches) Pale olive (5Y 6/3) loamy very fine sand; common medium distinct dark gray (5Y 4/1) mottles and streaks; weak medium subangular blocky structure; very friable; few roots; violently effervescent; clear wavy boundary.

C3g 67L597 74 to 86 cm (29 to 34 inches) Light olive gray (5Y 6/2) loamy fine sand; common medium faint olive (5Y 5/3) and few medium prominent yellowish brown (10YR 5/6) mottles; massive; very friable; about 5 percent very coarse sand and very fine gravel; slightly effervescent; clear wavy boundary.

C4g 67L598 86 to 91 cm (34 to 36 inches) Yellowish red (5YR 5/6) gravelly coarse sandy loam; massive; friable; horizon is discontinuous occupying about 60 percent of exposed faces; about 20 percent gravel, mostly less than 5 mm in diameter; slightly effervescent; abrupt smooth boundary.

IIC5g 67L599 91 to 112 cm (36 to 44 inches) Gray (5Y 5/1) silty clay; many fine distinct olive brown (2.5Y 4/4) mottles; moderate very fine angular blocky structure; friable; about 5 percent dark reddish brown (5YR 3/4) vertical pipestems 0.5 to 1.0 cm in diameter; about 2 percent soft whitish lime concretions 0.2 to 0.5 cm in diameter; strongly effervescent; clear smooth boundary.

IIC6g 67L600 112 to 142 cm (44 to 56 inches) Gray (5Y 5/1) silty clay; many fine faint dark gray

SOIL CLASSIFICATION-AERIC CALCIAQUOLL
COARSE-LOAMY OVER CLAYEY, FRIGID
SERIES - - - - - - -SERIES NOT DESIGNATED

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, MTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

SOIL NO - - - - - - S67MN-84-4 COUNTY - - - WILKIN

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 67L586-67L592 FEBRUARY 1977

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B															RATIO
		SAND	SILT	CLAY	FINE CLAY	SAND VCOS	SAND CORS	SAND MEDS	SAND FNES	SAND VFNS	SILT COSI	SILT FNSI	SILT VFSI	FAML TEXT	INTR II	FINE CLAY	NON-CO3-
		2- .05	.05- .002	LT .002	LT .0002	2- 1	1- .5	.5- .25	.25- .10	.10- .05	.05 .02	.02 .002	.002 .0005	SAND 2-.1	.2- .02	TO CLAY	CLAY
CM		PCT LT 2MM														PCT	PCT
C0C-25	AF	79.8	10.5	9.7		.3	1.6	3.0	32.2	42.7	5.1	5.4		37.0	73.6		10
C25-46	A3CA	80.9	8.5	10.6		.3	1.1	2.2	35.0	42.3	3.2	5.3		38.6	74.8		9
C46-61	C1CA	83.8	7.8	8.4		.2	.7	2.0	38.9	42.1	3.4	4.4		41.7	78.3		8
C61-86	C2	80.7	11.3	8.0		.2	.7	2.0	24.4	53.4	5.2	6.1		27.3	79.2		7
C86-107	2C3G	7.0	44.9	48.1		.1	.6	.7	2.0	3.6	1.6	43.3		3.4	6.6		47
107-142	2C4G	6.0	48.4	45.6		.5	1.0	1.2	2.0	1.2	1.6	46.8		4.7	4.0		44
142-165	2C5G	10.9	65.1	24.0		1.3	1.4	1.4	3.7	3.1	3.7	61.4		7.8	9.1		24

DEPTH	(PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2) VCL. GT 2	GT 75	75-20	20-5	5-2	LT .074	2C-2	BULK DENSITY 4A1D 1/3-BAR	4A1H OVEN DRY	4D1 COLE	4B1C 1/10 BAR	WATER CONTENT- 4B1C 1/3-BAR	4B2 15-BAR	4C1 WRC	CARBONATE 6E1B LT 2	3A1A LT .002	8C1A 1/1	8C1E 1/2
CM	PCT	PCT		WEIGHT		PCT	PCT	G/CC	G/CC		PCT	PCT	PCT	CM/ CM	PCT	PCT	H2O	CACL
C0C-25	TR	C	0	C	TR	33	TR	1.44	1.51	.016		14.6	6.0	.12	3	TR	7.6	
C25-46	TR	C	0	C	TR	31	TR	1.50A	1.54	.009	19.1		3.9	.23	6	2	7.9	
C46-61	TR	C	0	0	TR	29	TR	1.60B					2.9		6	TR	8.1	
C61-86	TR	C	0	TR	TR	40	TR	1.59A	1.62	.006	15.3		3.0	.20	11	1	8.2	
C86-107	TR	C	0	TR	TR	95	TR	1.37	1.48	.026		25.2	18.7	.11	19	2	8.0	
107-142	TR	C	0	TR	TR	95	TR	1.40B					19.2		16	2	7.9	
142-165	TR	C	0	TR	TR	91	TR	1.29	1.38	.023		36.7	14.0	.29	17	TR	8.0	

DEPTH	(ORGANIC MATTER) 6A1A ORGN	6B1A NITG	C/N	IRON 6C2A EXT FE	PHOS 6S1A TOTL	(EXTRACTABLE BASES 5B4A-) 6N2E CA	6O4C MG	6P2A NA	6Q2A K	SUM	ACTY 6H1A BACL EXTB	AL 6G1C KCL TEA	(CAT EXCH) 5A3A EXTB EXT	5A6A NH4AC ACTY	RATIO 8D2 NH4AC TC	RATIO 8D3 CA TC	CA 5F SAT NH4AC	(BASE SAT) 5C3 EXTB ACTY	5C1 NH4AC
CM	CARB PCT	PCT		PCT	PCT	(- - - - - - - - - - -MEQ / 100				EXTB	G- - - - - - - - - - -)				CLAY	MG	PCT	PCT	PCT
C0C-25	1.54C					3.1	.2	.3						14.3	1.43				
C25-46	.43					3.8	.4	.2						6.3	.70				
C46-61	.22					4.9	.8	.2						5.4	.68				
C61-86	.11					6.0	1.3	.1						5.2	.74				
C86-107	.27					27.3	6.0	.7						24.2	.51				
107-142	.15																		
142-165	.11					20.4	5.6	.6						16.5	.69				

DEPTH	(SATURATED PASTE) 8E1	8C1B	8A	NA 5D2	NA 5E	SALT 8D5	GYP 6F1A	(- - - - - - - - - - SATURATION EXTRACT 8A1- - - - - - - - - -) 8A1A	6N1B	6O1B	6P1A	6Q1A	6I1A	6J1A	6K1A	6L1A	6M1A	ATTERBERG 4F1	4F2
CM	CM		PCT	PCT		PPM	PCT	CM	(- - - - - - - - - - MEQ / LITER - - - - - - - - - -)									PCT	
C0C-25																			
C25-46																			
C46-61																			
C61-86																			
C86-107	27C	7.9	72.1	14		48CC		8.42			36.7								
107-142																			
142-165																			

(A) 1/10-BAR, METHOD 4A1G.
(B) ESTIMATED.
(C) 8 KG OF CARBON PER SQ METER TO A DEPTH OF 1 METER, METHOD 6A.

Soil classification: Aeric Calciaquoll; coarse-loamy over clayey, frigid.
Series: Not designated.
Pedon No.: S67MN-84-4.
Area: Wilkin County, Minnesota
Location: NW¼NE¼NE¼ sec. 27, T. 131 N., R. 45 W. (Bradford Twp.); about 1,100 feet west and 360 feet south of the northeast corner of section 27.
Climate: Some characteristics of temperature in degrees F. are: annual normal - 43, winter normal - 13, summer normal - 70; some characteristics of precipitation in inches are: mean annual - 21, May to September - 14, mean annual snowfall - 40.
Vegetation: Recently plowed field; native vegetation was species associated with tall prairie plant formation.
Parent material: Moderately shallow, calcareous, loamy and sandy glacio-lacustrine sediments over grayish, calcareous, clayey lacustrine sediments.
Physiography: Lake Agassiz plain; site occurs in immediate vicinity of the very weakly expressed Tintah beach ridge.
Topography: Site occurs at crest of an irregular shaped knoll; side slopes are about ½ percent.
Drainage: About somewhat poor or moderately well.
Erosion: None to slight.
Permeability: Moderately rapid in the upper part, slow in the lower part.
Sampled by: R. H. Jordan, G. S. Holmgren, R. A. Erickson, and H. R. Finney on October 19, 1967.
Described by: H. R. Finney.

Ap 67L586 0 to 25 cm (0 to 10 inches) Black (10YR 2/1) fine sandy loam; weak very fine and fine lar lar structure; very friable; abundant roots; strongly effervescent; abrupt smooth boundary.

A3ca 67L587 25 to 46 cm (10 to 18 inches) Very dark gray (10YR 3/1) grading to dark grayish brown (10YR 4/2) in the lower part, fine sandy loam; weak fine subangular structure; very friable; plentiful roots; violently effervescent; gradual smooth boundary.

C1ca 67L588 46 to 61 cm (18 to 24 inches) Dark grayish brown (10YR 4/2) light fine sandy loam; weak fine and medium subangular structure; very friable; few roots; violently effervescent; gradual wavy boundary.

C2 67L589 61 to 86 cm (24 to 34 inches) Light yellowish brown (2.5Y 6/4) loamy fine sand; common fine faint light brownish gray (2.5Y 6/2) and few fine faint yellowish brown (10YR 5/6) mottles; weak fine and medium subangular blocky structure; very friable; few roots; few fine soft black concretions 0.5 to 2.0 mm in diameter; slightly effervescent; abrupt smooth boundary.

IIC3g 67L590 86 to 107 cm (34 to 42 inches) Light olive gray (5Y 6/2) silty clay; common fine

[redacted]

friable; few roots; few fine soft black concretions 0.5 to 2.0 mm in diameter; strongly effervescent; gradual smooth boundary.

IIC4g 67L591 107 to 142 cm (42 to 56 inches) Light gray (5Y 6/1) silty clay; common fine distinct grayish brown (2.5Y 5/2) mottles; weak medium and coarse prismatic structure parting to weak fine and very fine angular blocky structure; firm; common fine prominent brown (7.5YR 4/4) soft concretions and vertical streaks; about 2 percent soft concretions of gypsum; strongly effervescent; diffuse smooth boundary.

SOIL CLASSIFICATION-TERRIC BOROSAPRIST
LOAMY, MIXED, EURIC
SERIES - - - - - - -NOT DESIGNATED

SOIL NO - - - - - - S72NE-35-1 COUNTY - - - KITTSON

GENERAL METHODS- - -1A,1B1E,2A1,2B SAMPLE NOS. 72L604-72L609

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, NTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

MARCH 1977

DEPTH	HORIZON	(- - - - - - - - - - - - - - PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B - - - - - - - - - -)															RATIO
		SAND 2- .05	SILT .05- .002	CLAY LT .002	CLAY LT .0002	VCOS 2- 1	CORS 1- .5	MEDS .5- .25	FNES .25- .10	VFNS .10- .05	COSI .05 .02	FNSI .02 .002	VFSI .005- .002	TEXT SAND 2-.1	II .2- .02	CLAY TO CLAY	CO3- CLAY	15- BAR TO CLAY
CM		(- PCT LT 2MM -)														PCT	PCT	
00-10	0A1																	
10-20	0A2																	
20-44	0A3																	
44-50	2A1B	43.2	36.9	19.9		2.6	4.4	6.9	15.7	13.6	16.5	20.4		29.6				
50-56	2C1GCA	55.5	28.6	15.9		3.7	5.6	8.7	19.5	18.0	15.3	13.3		37.5				
56-110	2C2G	48.7	34.7	16.6		6.9	7.7	6.3	15.4	12.4	16.4	18.3		36.3				

DEPTH	(PARTICLE SIZE ANALYSIS, MM, 3B, 3F1, 3B2)(	BULK DENSITY)(- - - -WATER CONTENT- - - -) CARBONATE (- -PH - -)

CM	GT 2 MM PCT	GT 75 MM PCT	75-20 MM (- - - PCT LT 75 - - -)	20-5 MM	5-2 MM	LT .074 MM LT20	20-2 MM PCT	1/3-BAR G/CC	OVEN DRY G/CC	COLE	1/10 BAR PCT	1/3-BAR PCT	15-BAR PCT	WRD CM/CM	LT 2 MM PCT	LT .002 MM PCT	1/1 H2O	1/2 CACL
00-10													51					
10-20								.21	.48	.33	392	358	83	.58				
20-44								.30	.54	.21	269	255	74	.59				
44-50													18					
50-56													13					
56-110													7					

DEPTH	(ORGANIC MATTER)		C/N	IRON	PHOS	(- -EXTRACTABLE BASES 5B4A- -)				ACTY	AL	(CAT EXCH)		RATIO	RATIO	CA	(BASE SAT)	
	6A1A ORGB CARB	6B1A WITG		6C2B EXT FE	TOTL	6N2E CA	6Q2D MG	6P2B NA	6Q2B K	SUM EXTB	6H1A BACL TEA	6G1E KCL EXT	5A3A EXTB ACTY	5A6A NHAC	8D1 NHAC TO CLAY	8D3 CA TO MG	5F1 SAT NHAC PCT	5C3 EXTB ACTY PCT	5C1 NHAC PCT
CM	PCT	PCT		PCT	PCT	(- - - - - - - - - - - - MEQ / 100 G- - - - - - - - - - - -)													
00-10	37.6					63.8	30.2	.4	1.2	95.6				107.0					
10-20	45.3					74.1	34.4	.6	.4	110.0				145.0					
20-44	34.6					67.0	31.3	.3	.3	98.9				113.0					
44-50														62.1					
50-56														17.8					
56-110														5.3					

DEPTH	(SATURATED PASTE)		NA	NA	SALT	GYP	(- - - - - - - - - - SATURATION EXTRACT 8A1- - - - - - - - - -)								ATTERBERG	
	8E1 REST OHM-	8C1B PH	8A H2O	5D2 ESP	5E SAR	8D5 TOTL SOLU MMHOS/	6F1A	8A1A PC	6N1B CA	6Q1B MG	6P1B NA	6Q1B K	6I1A CO3	6J1A HCO3	6K1A CL	6L1A SO4	6M1A NO3	4F1 LQID LMIT	4F2 PLST INDX
CM	CM		PCT	PCT		PPM	PCT	CM	(- - - - - - - - - - MEQ / LITER - - - - - - - - - -)									PCT	
00-10	600	7.2	326			8100		3.51	21.3	20.8	.6	.5	0	3.3	0	7.4	37.0		
10-20	790	7.2	507			9100		2.63	17.5	16.8	.5	.1	0	3.7	0	9.3	22.5		
20-44	1100	7.4	356			4100		1.72	10.5	10.0	.3	.1	0	2.8	0	6.6	11.8		
44-50																			

Pedon classification: Terric Borosaprist; loamy, mixed, euic.
Soil: Series not designated.
Soil No.: S72MN-35-1.
Location: Kittson County, Minnesota; near northwest corner of NE ¼, Sec. 30, T. 159 N., R. 45 W. About 48.7 deg. north latitude and 97.5 deg. west longitude.
Climate: Humid continental. Mean annual temperature is 38 deg. F.; mean summer temperature is 66 deg. F., and mean winter temperature is 6 deg. F. Mean annual precipitation is 20 inches; mean May through September precipitation is 14 inches; total annual snowfall is about 35 inches. Frost-free period is about 110 days.
Parent material: Organic soil material derived from herbaceous plants over loamy glacial till of the DesMoines lobe of the Late Wisconsin glaciation.
Physiography: Central lowlands; Lake Agassiz Plain; area is nearly level and local relief is mostly less than 5 feet. Elevation is about 1,060 feet.
Vegetation: Mostly sedges and grasses. Size of bog: About 100 acres.
Distance to mineral land: About 600 feet. Microrelief: Very slight.
Depth to water table: Below 100 cm. Subsidence: Slight.
Described and sampled by: D. D. Barron, J. O. Nordin, R. S. Farnham, W. E. McKinzie, W. C. Lynn, and H. R. Finney on July 27, 1972. Samples were obtained from a pit that was dug with a spade.

Oa1 72L604 0 to 10 cm Very dark brown (10YR 2/2, broken face) sapric material, black (10YR 2/1, rubbed); about 5 percent fiber, trace rubbed; weak very fine crumb structure; very friable; herbaceous fiber; about 25 percent mineral material; very slightly effervescent; clear smooth boundary.

Oa2 72L605 10 to 20 cm Dark brown (7.5YR 3/2, broken face) fiber and black (10YR 2/1, broken face) matrix, sapric material, very dark brown (10YR 2/1, rubbed); about 60 percent fiber, about 10 percent rubbed; weak thin and medium platy structure; very friable; herbaceous fiber; about 20 percent mineral material; slightly effervescent; clear smooth boundary.

Oa3 72L606 20 to 44 cm Black (N 2/, broken face and rubbed) sapric material; about 10 percent fiber, trace rubbed; weak fine platy structure; very friable; herbaceous fiber; about 60 percent mineral material; few fragments of snail shells; few limy masses; strongly effervescent; clear smooth boundary.

IIA1b 72L607 44 to 50 cm Black (N 2/) mucky loam; weak medium and thick platy structure; slightly sticky; about 5 percent coarse fragments; very slightly effervescent; abrupt wavy boundary.

IIC1gca 72L608 50 to 56 cm Dark gray (2.5Y 4/1) loam; massive; slightly sticky; about 5 percent coarse fragments; violent effervescent; clear smooth boundary.

IIC2g 72L609 56 to 110 cm Light olive gray (5Y 6/2) loam; few fine distinct light olive brown (2.5Y 5/6) mottles; massive; slightly sticky; about 5 percent coarse fragments; strongly effervescent; gradual boundary.

IIC3 (not sampled) 110 to 120 cm Light olive brown (2.5Y 5/4) loam; many fine distinct grayish and few fine prominent reddish brown mottles; weak fine platy structure parting to weak fine angular blocky structure; slightly sticky; about 5 percent coarse fragments; strongly effervescent.

Remarks: Bulk samples were collected at depths of 0-10, 10-20, 20-44, 44-50, 50-56, and 56-110 cm. Samples primarily for determination of fiber were collected at depths of 0-10, 10-20, and 20-44 cm. Samples for determination of bulk density were collected at depths of 0-10, 10-20, 20-25, and 31-36 cm.

SOIL CLASSIFICATION-TYPIC BOROHEMIST
LOAMY, MIXED, EUIC
SERIES - - - - - - -NOT DESIGNATED

SOIL NO - - - - - - S72MN-36-2 COUNTY - - - KOOCHICHING

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 72L594-72L599

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LINCOLN, NEBRASKA

MARCH 1977

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B														RATIO	
		FINE (- - - - - SAND - - - - -)(- - SILT- - -)											FAML	INTR	FINE	NON-	8D1
		SAND	SILT	CLAY	CLAY	VCOS	CORS	MEDS	FNES	VFNS	COSI	FNSI	VFSI	TEXT	II	CLAY	CO3-	15-
		2-	.05-	LT	LT	2-	1-	.5-	.25-	.10-	.05	.02	.005-	SAND	.2	TO	CLAY	BAR
		.05	.002	.002	.0002	1	.5	.25	.10	.05	.02	.002	.002	2-.1	.02	CLAY		TO
CM		(- PCT LT 2MM -)														PCT	PCT	CLAY
010-000	01																	
000-025	0E																	
025-040	0I																	
040-150	0A																	
150-155	2A1B																	
155-160	2C1G																	

DEPTH	(PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2)(BULK DENSITY)(- - - -WATER CONTENT- - - -)										CARBONATE		(- -PH - -)	
	VOL. (- - - - - - - WEIGHT - - - - - - -)					4A1D	4A1H	4D1	4B1C	4B1C	4B2A	4C1	6F1B	3A1A	8C1A	8C1E
	GT	GT	75-20	20-5	5-2	LT	20-2	1/3-	OVEN	COLE	1/10	1/3-	15-	WRD	LT	LT	1/1	1/2
	2	75				.074	PCT	BAR	DRY		BAR	BAR	BAR	CM/	2	.002	H2O	CACL
CM	PCT	PCT	(- - - PCT LT 75 - - -)			LT20	G/CC	G/CC			PCT	PCT	PCT	CM	PCT	PCT		
010-000																		
000-025													97					
025-040													97					
040-150													87					
150-155																		
155-160																		

DEPTH	(ORGANIC MATTER)			IRON	PHOS	(- -EXTRACTABLE BASES 5B4A- -)					ACTY	AL	(CAT EXCH)		RATIO	RATIO	CA	(BASE SAT)	
	6A1A	6B1A	C/N	6C2B		6N2E	6Q2D	6P2B	6Q2B		6H1A	6G1E	5A3A	5A6A	8D1	8D3	5F1	5C3	5C1
	ORGN	NITG		EXT	TOTL	CA	MG	NA	K	SUM	BACL	KCL	EXTB	NHAC	NHAC	CA	SAT	EXTB	NHAC
	CARB			FE						EXTB	TEA	EXT	ACTY		TO	TO	NHAC	ACTY	
CM	PCT	PCT		PCT	PCT	(- - - - - - - - - - -MEQ / 100					G- - - - - - - - - - -)				CLAY	MG	PCT	PCT	PCT
010-000																			
000-025	50.4					15.5	9.1	.5	2.5	27.6	98.9		122	90.2		1.7	17	23	31
025-040	58.8					20.0	10.5	.5	2.0	33.0	126.0		159	118.0		1.9	17	21	28
040-150	56.6					89.9	39.5	.6	.2	130.0	105.0		235	155.0					
150-155																			
155-160																			

DEPTH	(SATURATED PASTE)			NA	NA	SALT	GYP	(- - - - - - - - - - SATURATION EXTRACT 8A1- - - - - - - - - -)										ATTERBERG	
	8E1	8C1B	8A	5D2	5E	8D5	6F1A	8A1A	6N1B	6O1B	6P1B	6Q1B	6I1A	6J1A	6K1A	6L1A	6M1A	4F1	4F2
	REST	PH	H2O	ESP	SAR	TOTL		EC	CA	MG	NA	K	CO3	HCO3	CL	SO4	NO3	LQID	PLST
	OHM-					SOLU		MMHOS/										LMIT	INDX
CM	CM		PCT	PCT		PPM	PCT	CM	(- - - - - - - - - - MEQ / LITER - - - - - - - - - -)									PCT	
010-000																			
000-025	7700	3.7	1618			1600		.15	.3	.2	.1	.6	0	0	0	0			
025-040	11600	3.6	1527			980		.10	.3	.2	TR	.3	0	0	0	0			
040-150	8300	5.5	817			580		.11	.6	.6	.1	TR	0	.9	0	0			
150-155																			
155-160																			

DEPTH	(- - - - - - - - - - - - - - -HISTOSOL CHARACTERIZATION- - - - - - - - - - - - - - -)													
	(STATE OF DECOMPOSITION)			PH	(BULK DEN)		COLE	SUBS	(- -WATER CONTENT- -)					
	8F	8G		8H	8C1E	4A3A	4A1I	4D1		4B4	4B1C	4B2	4C1	
	MINL	(FIBER	VOL)	PYROPHOSPHT	.01M	FILD	1/3B	RE-	RES-	FILD	1/3B	15-	WRD	
	CONT	UNRB	RUB	SOLUBILITY	CACL	STAT	REMT	WET	IDUE	STAT	REMT	BAR	CM/	
CM	PCT	PCT	PCT			G/CC	G/CC		PCT	PCT	PCT	PCT	CM	
010-000		94	75	10YR 8/2	3.6									
000-025	13	76	52	7.5YR 5.5/4	3.2	.08			28	1170		59		
025-040	10	92	55	10YR 7/4	3.3	.06			30	1850		89		
040-150	10	84	20	7.5YR 5/4	4.6	.07			35	1300		77		
150-155		<5		7.5YR 3/2	5.4									
155-160		<5		7.5YR 4/2	3.9									

Pedon classification: Terric Borohemist; loamy, mixed, euic (see remarks).
Soil: Series not designated.
Soil No.: S72MN-36-2.
Location: Koochiching County; Big Falls Experimental Forest; SE ¼, SE ¼, Sec. 14, T. 68 N., R. 27 W. About 48.5 deg. north latitude and about 94.2 deg. west longitude.
Climate: Humid continental. Mean annual temperature is 37 deg. F.; mean summer temperature is 64 deg. F.; mean winter temperature is 8 deg. F. Mean annual precipitation is 24 inches; mean May through September precipitation is 16 inches; total annual snowfall is about 55 inches. Frost-free period is about 100 days.
Parent material: Organic soil material derived from woody, herbaceous, and mossy plants over medium textured glacial lacustrine sediments.
Physiography: Central lowlands; Agassiz Lacustrine Plain (Big Fork Valley). Area is nearly level and

SOIL CLASSIFICATION-TERRIC BOROSAPRIST
LOAMY, MIXED, EUIC
SERIES - - - - - - -NOT DESIGNATED

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SOIL NO - - - - - - S73NN-69-3 COUNTY - - - ST. LOUIS

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 73L623-73L624 MARCH 1977

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B														RATIO
		SAND	SILT	CLAY	FINE CLAY	VCOS SAND	CORS SAND	MEDS SAND	FNES SAND	VFNS SAND	COSI SILT	FNSI SILT	VFSI SILT	FSML TEXT	INTR II	FINE CLAY	NON-CO3-	8D1 15-BAR
		2- .05	.05- .002	LT .002	LT .0002	2- 1	1- .5	.5- .25	.25- .10	.10- .05	.05 .02	.02 .002	.005- .002	SAND 2-.1	.2- .02	TO CLAY	CLAY	TO CLAY
CM		PCT LT 2MM														PCT	PCT	
8-60	0A2																	
60-107	0A3																	

DEPTH	HISTOSOL CHARACTERIZATION											SHEAR STRENGTH
	(STATE OF DECOMPOSITION)			PH	(BULK DEN)		COLE	SUBS	(- -WATER CONTENT- -)			
	8F	8G	8H	8C1E	4A3A	4A1I	4D1		4B4	4B1C	4B2	4C1	
	MINL	FIBER VOL	PYROPHOSPHT	.01M	FILD	1/3B	RE-	RES-	FILD	1/3B	15-	WRD	(A)

CM	CCNT PCT	UNRB PCT	RUB PCT	SOLUBILITY		CACL	STAT G/CC	REWT G/CC	WET	IDUE PCT	STAT PCT	REWT PCT	BAR PCT	CM/CM	KPA
8-60	16	48	4	10YR	4/2	4.9									
60-107	8	54	12	10YR	5/3	4.8	.15			77	600				11.5

(A) KPA = KILOPASCAL.

Pedon classification: Terric Borosaprist; loamy, mixed, euic.
Soil: Series not designated.
Soil No.: S73MN-69-3.
Location: St. Louis County, Minnesota; about 4-1/2 miles east of Meadowlands; about 100 feet north and 75 feet east of southwest corner of Sec. 16, T. 53 N., R. 18 W.; about 47.1 deg. north latitude and about 92.7 deg. west longitude.
Climate: Humid continental. Mean annual temperature is 39 deg.F.; mean summer temperature is 64 deg. F.; and mean winter temperature is 11 deg.F. Mean annual precipitation is 28 inches; May through September precipitation is 18 inches; mean annual snowfall is 60 inches. Frost-free period is 84 days.
Parent material: Organic soil material from woody and herbaceous plants over loam glacial lacustrine sediments of Late Wisconsin age.
Physiography: Central lowlands; Upham Lacustrine Plain. Site is about 4 miles from the border of the plain and the morainic uplands. The plain is level in this vicinity. Elevation is 1,290 feet. Slope of bog is about 8 feet per mile to the northwest.
Vegetation: White cedar forest with about 95 percent crown cover. The herbaceous layer and ground cover is rather sparse. Dominant plants are lingonberry, bog laurel, labrador tea, hypnum moss, lichens, and polytricum.
Size of bog: About 20 square miles.
Distance to adjacent mineral land: About 1 mile.
Microrelief: Hummocky with microrelief of about 20 inches.
Depth to water table: About 40 inches.
Subsidence: Slight; roadside ditch about 100 feet south of the site.
Observers: The pedon was described, samples collected, and shear strength measured on July 11, 1973, by E. L. Bruns, J. H. Day, L. Dunnigan, R. S. Farnham, H. R. Finney, M. Levesque, W. C. Lynn, and W. E. McKinzie. Samples were obtained from a hand-dug pit and with a spade.

Oa1 0 to 8 cm Black (10YR 2/1, broken face, rubbed, and pressed) sapric material; about 20 percent fiber, about 5 percent rubbed; weak fine granular structure; very friable, slightly sticky; woody fiber; about 15 percent mineral material; clear smooth boundary.

Oa2 8 to 60 cm Black (10YR 2/1, broken face) matrix and dark brown (7.5YR 3/2, broken face)

SOIL CLASSIFICATION-AQUOLLIC OCHRAQUALF
FINE-LOAMY, MIXED, MESIC
SERIES - - - - - - -SKYBERG TAXADJUNCT

SOIL NO - - - - - - S70MN-20-3 COUNTY - - - DODGE

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 70L1079-70L1088

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LINCOLN, NEBRASKA

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B															RATIO
		SAND 2- .05	SILT .05- .002	CLAY LT .002	FINE CLAY LT .0002	SAND VCOS 2- 1	SAND CORS 1- .5	SAND MEDS .5- .25	SAND FNES .25- .10	SAND VFNS .10- .05	SILT COSI .05 .02	SILT FNSI .02 .002	SILT VFSI .005- .002	FAML TEXT SAND 2-.1	INTR II .2- .02	FINE CLAY TO CLAY	NON- CO3- CLAY	8D1 15- BAR TO
CM		PCT LT 2MM														PCT	PCT	CLAY
000-22	AP	15.3	57.7	27.0	12.6	.2	3.1	3.9	5.3	2.8	24.3	33.4		12.5	29.7	47	27	.47
022-31	B1	11.6	59.8	28.4	15.3	.3	2.5	2.9	3.9	2.2	24.9	34.9		9.6	29.0	54	28	.42
031-40	B21	9.9	61.2	28.9	16.0	.2	1.8	2.3	3.4	2.2	26.5	34.7		7.7	30.4	55	29	.43
040-58	B22	26.9	46.7	26.4	14.9	1.6	4.3	5.5	9.7	5.8	21.9	24.8		21.1	32.6	56	26	.42
058-79	2B23	46.5	29.1	24.4	11.6	2.6	7.1	9.1	17.4	10.3	12.8	16.3		36.2	32.1	48	24	.38
079-106	2B24t	43.9	31.5	24.6	13.6	2.5	7.0	8.1	15.9	10.4	14.0	17.5		33.5	32.9	55	25	.40
106-133	2B25t	44.1	30.8	25.1	10.8	3.3	6.8	7.4	15.4	11.2	13.7	17.1		32.9	33.1	43	25	.41
133-175	2C1	45.3	33.5	21.2	8.1	4.3	7.7	7.8	15.0	10.5	15.2	18.3		34.8	33.7	38	21	.43
175-200	2C2	47.8	33.4	18.8	7.8	3.7	7.6	8.7	16.5	11.3	15.4	18.0		36.5	35.4	41	19	.43
200-270	2C3	51.3	32.4	16.3	5.7	4.4	8.1	9.3	17.7	11.8	15.4	17.0		39.5	36.4	35	16	.45

DEPTH	PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2 VOL.	WEIGHT					BULK DENSITY			WATER CONTENT			CARBONATE		PH	
	GT 2	GT 75	75-20	20-5	5-2	LT .074	4A1D 20-2	4A1H 1/3- BAR	4D1 OVEN DRY	4B1C COLE	4B1C 1/10 BAR	4B2 1/3- BAR	4B2 15- BAR	4C1 WRD CM/ CM	6E1B LT 2	3A1A LT .002	8C1A 1/1 H2O	8C1E 1/2 CACL
CM	PCT	PCT	PCT LT 75				LT20	G/CC	G/CC		PCT	PCT	PCT		PCT	PCT		
000-22	TR	0	0	TR	TR	86	TR	1.47	1.64	.038	27.6	26.5	12.8	.21	6.1B		6.7	6.7
022-31	TR	0	0	TR	TR	89	TR	1.47	1.59	.027	27.6	26.1	12.0	.21	2.3B		5.3	5.0
031-40	0	0	0	0	0	92	0	1.38	1.51	.031	30.9	28.7	12.3	.23	1.7B		4.9	4.5
040-58	1	0	TR	1	1	75	2	1.38	1.50	.029	23.4	22.6	11.0	.16	1.7B		4.6	4.3
058-79	TR	0	0	TR	1	58	1	1.50A					9.2				4.7	4.2
079-106	1	0	0	TR	1	61	1	1.60A					9.8				5.1	4.6
106-133	2	0	TR	1	2	61	3	1.69	1.86	.033	17.8	16.9	10.4	.11	2.3B	1	7.4	7.5
133-175	2	0	TR	1	2	59	3	1.85	1.93	.015	14.9	13.9	9.1	.09	2.8B	9 0	7.9	7.6
175-200	3	0	TR	1	3	56	4	1.77	1.89	.021	16.9	15.6	8.1	.13		11 0	8.0	7.7
200-270		0	0	1	3	53	4						7.3			12 0	8.2	7.8

DEPTH	ORGANIC MATTER 6A1A ORGN CARB	6B1A NITG	C/N	IRON 6C2B EXT FE	PHOS TOTL	EXTRACTABLE BASES 5B4A- 6N2E CA	6O2D MG	6P2B NA	6Q2B K	SUM EXTB	ACTY 6H1A BACL TEA	AL 6G1E KCL EXT	CAT EXCH 5A3A EXTB ACTY	5A6A NHAC	RATIO 8D1 NHAC TO CLAY	RATIO 8D3 CA TO MG	CA 5F1 SAT NHAC	BASE SAT 5C3 EXTB ACTY	5C1 NHAC
CM	PCT	PCT		PCT	PCT	MEQ / 100 G											PCT	PCT	PCT
000-22	2.53C	.224	11	1.0		19.8	7.0	0.1	0.4	27.3	6.4		33.7	26.3	0.97	2.8	75	81	104
022-31	0.73	.094	8	1.1		11.7	4.3	0.2	0.4	16.6	9.2	0.4	25.8	20.2	0.71	2.7	58	64	82
031-40	0.40	.062	6	1.1		11.2	3.6	0.2	0.4	15.4	10.8	1.8	26.2	20.4	0.71	3.1	55	59	75
040-58	0.27	.037	7	1.3		10.1	3.0	0.2	0.4	13.7	9.8	2.2	23.5	18.3	0.69	3.4	55	58	75
058-79	0.15			1.6		7.0	2.3	0.2	0.3	9.8	6.3	1.1	16.1	12.8	0.52	3.0	55	61	77
079-106	0.11			1.9		8.7	2.3	0.2	0.3	11.5	4.7	0.3	16.2	13.1	0.53	3.8	66	71	88
106-133	0.07			1.5		13.4D	2.3D	0.2	0.3	16.2				13.0	0.52				
133-175	0.03			1.3		15.7D	2.2D	0.2	0.3	18.4				10.5	0.50				
175-200	0.03			1.1		14.4D	2.1D	0.2	0.3	17.0				9.3	0.49				
200-270	0.02			0.7		14.1D	1.8D	0.2	0.2	16.3				7.8	0.48				

DEPTH	SATURATED PASTE 8E1 REST OHM-	8C1B PH	8A H2O	NA 5D2 ESP	NA 5E SAR	SALT 8D5 TOTL SOLU	GYP 6F1A	SATURATION EXTRACT 8A1- 8A1A EC	6N1B CA	6O1B MG	6P1B NA	6Q1B K	6I1A CO3	6J1A HCO3	6K1A CL	6L1A SO4	6M1A NO3	ATTERBERG 4F1 LQID LMIT	4F2 PLST INDX
CM	CM		PCT	PCT		PPM	PCT	MMHOS/ CM	MEQ / LITER									PCT	
000-22																		42E	16
022-31																			
031-40																			
040-58																		38E	17
058-79																			
079-106	5000	4.8	36.5	2		40		0.21	1.0	0.3	0.3	0.1							
106-133																			
133-175																			
175-200																		29E	15
200-270																			

ANALYSES BY MINNESOTA AGRICULTURAL EXPERIMENT STATION, ST PAUL, MN. MINERALOGY, X-RAY ANALYSIS. TOTAL PHOSPHORUS, NITRIC-PERCHLORIC DIGESTION. AVAILABLE PHOSPHORUS, BRAY'S NO 1 EXTRACTANT.

DEPTH	MINERALOGY MONT	VERM	ILLITE	KAOL	QUARTZ	TOTAL P	AVAIL P
CM	PCT LT .002 MM					LBS/A	
000-22	30	20	40	10	0	1354	53
022-31	35	20	30	10	5		12
031-40	40	20	30	5	5		9
040-58	40	20	30	10	0	666	9
058-79	35	15	30	15	5	784	10
079-106	25	15	40	20	0		18
106-133	35	15	30	15	5		25
133-175	40	10	30	15	5	1070	4
175-200	40	15	35	10	0		5
200-270	40	15	35	10	0	868	8

(A) ESTIMATED.
(B) MICRO-PENETRATION RESISTANCE - A ROD 0.6 CM DIA IS SLOWLY PUSHED INTO BULK DENSITY CLOD, EQUILIBRATED AT 1/10-BAR, A DISTANCE OF 0.6 CM USING A POCKET PENETROMETER. UNITS ARE FORCE (KG) AND NOT ESTIMATES OF UNCONFINED COMPRESSIVE STRENGTH.
(C) ORGANIC CARBON IS 11 KG/M SQ TO A DEPTH OF 1 M (6A).
(D) METHOD 6N4C FOR CA AND 6O4C FOR MG.
(E) DETERMINED BY SOIL MECHANICS LAB - SCS, LINCOLN, NE.

Pedon classification: Aquollic Hapludalf; fine-loamy, mixed, mesic.
Series classification: Udollic Ochraqualfs; fine-loamy, mixed, mesic.
Soil: Skyberg taxadjunct*.
Soil No.: S70MN-20-3.
Location: Dodge County, Minnesota; about 4 miles north of Hayfield; about 200 feet east and 400 feet south of the northwest corner of SE1/4 of NW1/4, Sec. 35, T. 106 N., R. 17 W. About 92 deg. 50 min. west longitude, and about 43 deg. 57 min. north latitude.
Climate: Humid continental. Some features of precipitation in inches: annual normal - 29, May through September - 19, annual normal snowfall - 40. Some features of temperature in deg. F.: annual normal - 45, summer normal - 70, winter normal - 18.
Parent material: Loamy mantle (loess?) over loamy calcareous Kansan(?) till with a thin intervening stone line.
Physiography: Central Lowlands; Iowan Erosion Surface (Ruhe); Rochester Till Plain (Wright); Kenyon-Taopi Plain, silty, undulating (MN Soil Atlas).
Landscape setting: Site has a 1/2 percent slight convex slope on the crest of a broad summit. Topography in the immediate vicinity is gently rolling, and relative relief is about 20 feet. Elevation is about 1,315 feet. Major soils in the area are of the Kasson, Racine, and Skyberg series.
Vegetation: Corn field. Native vegetation was tall grass prairie or savanna.
Drainage: Somewhat poorly drained.
Erosion: Slight.
Moisture: Moist to wet. Area recently had prolonged heavy rains. Water entered the pit at the contact of the two sediments and between prism faces.
Root distribution: Common to 23 inches; few below.
Permeability: Moderate in upper part of solum grading to slow or moderately slow in the IIC horizon.
Described by: J. F. Cummins on October 20, 1970.
Sampled by: R. B. Grossman, E. R. Gross, and J. F. Cummins on October 20, 1970.

Ap 70L1079 0 to 22 cm (0 to 9 inches) Very dark gray (10YR 3/1) silt loam; weak fine subangular blocky structure; friable; abrupt smooth boundary.

B1 70L1080 22 to 31 cm (9 to 12 inches) Dark grayish brown (10YR 4/2) silt loam; few fine distinct light olive brown (2.5Y 5/4) mottles; few very dark gray (10YR 3/1) wormcasts; weak medium platy structure parting to weak very fine subangular blocky structure; friable; many fine tubular pores; abrupt smooth boundary.

B21 70L1081 31 to 40 cm (12 to 16 inches) Olive brown (2.5Y 4/3) silt loam high in content of sand; few fine distinct dark gray (2.5Y 4/1) and light olive brown (2.5Y 5/6) mottles; moderate fine and medium subangular blocky structure; friable; many fine tubular pores; fine Fe-Mn oxide masses; abrupt wavy boundary.

B22 70L1082 40 to 58 cm (16 to 23 inches) Olive brown (2.5Y 4/3) loam; few fine faint dark gray (10YR 4/1) and light olive brown (2.5Y 5/6) mottles; moderate fine and medium subangular blocky structure; friable; many fine tubular pores; few Fe-Mn oxide masses; clear wavy boundary.

IIB23 70L1083 58 to 79 cm (23 to 31 inches) Light brownish gray (2.5Y 6/2) loam; light brownish gray (2.5Y 6/2) ped faces; many fine distinct light olive brown (2.5Y 5/8) mottles; moderate medium and coarse prismatic structure parting to moderate fine and medium subangular and angular blocky structure; friable; few Fe-Mn oxide masses; about 8 percent coarse fragments in upper part and about 4 percent in remainder; clear wavy boundary.

IIB24t 70L1084 79 to 106+ cm (31 to 42+ inches) Yellowish brown (10YR 5/4) loam; light brownish gray (2.5Y 6/2) ped faces; many fine distinct light olive brown (2.5Y 5/8) mottles; moderate medium and coarse prismatic structure parting to moderate fine and medium subangular and angular blocky structure; friable; few Fe-Mn oxide masses; about 8 percent coarse fragments in upper part and about 4 percent in remainder; clear wavy boundary.

SOIL CLASSIFICATION-AERIC CALCIAQUOLL
SANDY, FRIGID
SERIES - - - - - - -ULEN

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, MTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

SOIL NO - - - - - - S67MN-54-5 COUNTY - - - NORMAN

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 67L610-618 FEBRUARY 1977

DEPTH CM	HORIZON	SAND 2-.05	SILT .05-.002	CLAY LT .002	FINE CLAY LT .0002	VCOS 2-1	CORS 1-.5	MEDS .5-.25	FNES .25-.10	VFNS .10-.05	COSI .05-.02	FNSI .02-.002	VFSI .005-.002	FAML TEXT SAND 2-.1	INTR II .2-.02	FINE CLAY TO CLAY PCT	NON-CO3-CLAY PCT	RATIO 8D1 15-BAR TO CLAY
		(- - - PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B; PCT LT 2MM - - -)																
000-25	AP	85.6	8.0	6.4		.1	.8	2.0	46.0	36.7	3.9	4.1		48.9	81.7		5	.67
025-38	A3CA	79.1	9.0	11.9		TR	.7	1.7	42.4	34.3	4.1	4.9		44.8	76.2		7	.44
038-51	C1CA	83.2	8.2	8.6		.1	.7	1.7	46.1	34.7	3.5	4.7		48.5	79.3		6	.42
051-66	C2CA	85.2	7.2	7.6		.1	.9	1.5	48.7	34.0	2.9	4.3		51.2	81.6		5	.42
066-81	C3	87.5	6.8	5.7		TR	.2	.6	49.2	37.5	3.2	3.6		50.0	88.9		5	.39
081-99	C4	91.0	6.0	3.0		.0	.2	.5	51.9	38.5	2.6	3.4		52.5	92.2		3	
099-140	C5	94.2	4.4	1.4		.1	.3	.4	57.4	36.0	2.1	2.3		58.2	94.8		1	
053-71	C2CA	88.4	7.3	4.3		.1	1.1	2.1	53.8	31.2	2.3	5.0		57.1	81.6		3	
071-86	C3CA	77.7	11.6	10.7		.1	.2	.6	41.7	35.1	3.9	7.7		42.6	79.6		6	.67

DEPTH CM	(PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2) VOL. GT 2 PCT	WEIGHT GT 75 PCT	75-20 PCT LT 75	20-5 PCT LT 75	5-2 PCT LT 75	LT .074 PCT LT 75	20-2 PCT LT20	(BULK DENSITY) 4A1D 1/3-BAR G/CC	4A1H OVEN DRY G/CC	4D1 COLE	(WATER CONTENT) 4B1C 1/10 BAR PCT	4B1C 1/3-BAR PCT	4B2 15-BAR PCT	4C1 WRD CM/CM	CARBONATE 6E1B LT 2 PCT	3A1A LT .002 PCT	(PH) 8C1A 1/1 H2O	8C1E 1/2 CACL
000-25	0	0	0	0	0	24	0	1.56	1.58	.004		19.0	4.3	.23	5	1	8.0	
025-38	0	0	0	0	0	30	0	1.61	1.63	.004		17.6	5.2	.20	13	5	8.2	
038-51	TR	0	0	TR	TR	26	TR	1.60A					3.6		11	3	8.3	
051-66	TR	0	0	0	TR	23	TR	1.66B	1.65		15.0		3.2	.20	13	3	8.4	
066-81	TR	0	0	0	TR	24	TR	1.63B	1.62		15.8		2.2	.22	15	1	8.3	
081-99	0	0	0	0	0	15	0	1.60A					.7		13	TR	8.3	
099-140	TR	0	0	TR	TR	17	TR	1.60B	1.53			15.0	.6	.23	13	TR	8.4	
053-71	0	0	0	0	0	21	0						1.6		10	1	8.4	
071-86	TR	0	0	0	TR	32	TR						7.2		21	5	8.1	

DEPTH CM	(ORGANIC MATTER) 6A1A ORGN CARB PCT	6B1A NITG PCT	C/N	IRON 6C2A EXT FE PCT	PHOS 6S1A TOTL PCT	(EXTRACTABLE BASES 5B4A) 6N2E CA	6O4C MG	6P2A NA	6Q2A K	SUM EXTB	ACTY 6H1A BACL TEA	AL 6G1C KCL EXT	(CAT EXCH) 5A3A EXTB ACTY	5A6A NHAC	RATIO 8D2 NHAC TO CLAY	RATIO 8D3 CA TO MG	CA 5F SAT NHAC PCT	(BASE SAT) 5C3 EXTB ACTY PCT	5C1 NHAC PCT
						(- - - MEQ / 100 G - - -)													
000-25	1.550	.138	11				2.8	.1	.1					9.4	1.88				
025-38	.56	.051	11				3.6	.1	.1					5.5	.79				
038-51	.44	.042	10				2.3	.1	.1					3.5	.58				
051-66	.22						1.2	.1	.1					1.8	.36				
066-81	.11						.7	.1	.1					1.6	.32				
081-99	.04						.5	.1	.1					.9					
099-140	.04						.4	.1	.1					.8					
053-71	.11						1.0	.1	.1					1.9					
071-86	.40						1.2	.1	.1					2.6					

DEPTH CM	(SATURATED PASTE) 8E1 REST OHM-CM	8C1B PH	8A H2O PCT	NA 5D2 ESP PCT	NA 5E SAR	SALT 8D5 TOTL SOLL PPM	GYP 6F1A PCT	(SATURATION EXTRACT 8A1) 8A1A EC MMHOS/CM	6N1B CA	6O1B MG	6P1A NA	6Q1A K	6I1A CO3	6J1A HCO3	6K1A CL	6L1A SO4	6M1A NO3	ATTERBERG 4F1 LQID LMIT PCT	4F2 PLST INDX
									(- - - MEQ / LITER - - -)										
000-25																			
025-38																			
038-51																			
051-66																			
066-81																			
081-99																			
099-140	8400	8.1	24.5			100		.61											
053-71																			
071-86																			

(A) ESTIMATED.
(B) 1/10-BAR, METHOD 4A1G.
(C) 10 KG OF CARBON PER SQ METER TO A DEPTH OF 1 METER, METHOD 6A.

Soil classification: Aeric Calciaquoll; sandy, frigid.
Series: Ulen series.
Pedon No.: S67MN-54-5.
Area: Norman County, Minnesota
Location: SE¼SE¼SE¼ sec. 19, T. 144 N., R. 44 W. (Wild Rice Tps.); 20 feet south and 430 feet west of the junction of windbreak and north-south township road in that corner of section 19.
Climate: Some characteristics of temperature in degrees F. are: annual normal - 41, winter normal - 10, summer normal - 68; some characteristics of precipitation in inches are: mean annual - 20, May to September - 14, mean snowfall - 35.
Vegetation: Recently plowed field that was in small grains this summer.
Parent material: Sandy, calcareous, lacustrine sediments associated with glacial Lake Agassiz.
Physiography: Glacial Lake Agassiz plain; site occurs in an area between the Campbell and Norcross beach ridges.
Topography: Slope at sample site is about 1 percent to the south; site occurs on the lower part of a gently or very undulating area. Local relief is about 2 to 4 feet. Slope at site is slightly convex.
Drainage: Moderately well to somewhat poorly drained.
Ground water: At 70 inches.
Permeability: Moderately rapid.
Moisture: Moist throughout.
Sampled by: R. H. Jordan, G. S. Holmgren, D. D. Barron, and H. R. Finney on October 17, 1967.
Described by: H. R. Finney.

Ap 67L610 0 to 25 cm (0 to 10 inches) Black (10YR 2/1) light fine sandy loam; weak medium subangular blocky structure parting to weak fine granular structure; very friable; roots plentiful; strongly effervescent; abrupt smooth boundary.

A3ca 67L611 25 to 38 cm (10 to 15 inches) Very dark gray (10YR 3/1) light fine sandy loam; weak fine and medium subangular blocky structure; very friable; roots plentiful; violently effervescent; clear wavy boundary.

C1ca 67L612 38 to 51 cm (15 to 20 inches) Dark grayish brown (10YR 4/2) heavy loamy fine sand; few fine faint grayish brown (10YR 5/2) mottles; weak fine and medium subangular blocky structure; very friable; roots few; violently effervescent; clear smooth boundary.

C2ca 67L613 51 to 66 cm (20 to 26 inches) Yellowish brown (10YR 5/4) fine sand near loamy fine sand border; weak medium subangular blocky structure breaking easily to single grains; very friable; roots few; about 5 percent root channel fillings of dark grayish brown (2.5YR 4/2) strongly effervescent; clear smooth boundary.

C3 67L614 66 to 81 cm (26 to 32 inches) Brownish yellow (10YR 6/6) fine sand; weak medium subangular blocky structure breaking easily to single grains; very friable; roots few; discontinuous horizon occupying about 60 percent of the faces of the pit; slightly effervescent; clear smooth boundary.

C4 67L615 81 to 99 cm (32 to 39 inches) Olive yellow (2.5Y 6/6) to brownish yellow (10YR 6/6) fine

SOIL CLASSIFICATION-AERIC CALCIAQUOLL
SANDY, FRIGID
SERIES - - - - - - -ULEN

SOIL NO - - - - - - S67MN-54-6 COUNTY - - - NORMAN

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 67L619-67L625

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, MTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

FEBRUARY 1977

[redacted]

					FINE	(- - - - - - SAND - - - - - -)(- - -SILT- - - -)							FAML	INTR	FINE	NON-	8D1
		SAND	SILT	CLAY	CLAY	VCOS	CORS	MEDS	FNES	VFNS	COSI	FNSI	VFSI	TEXT	II	CLAY	CO3-	15-
		2-	.05-	LT	LT	2-	1-	.5-	.25-	.10-	.05	.02	.005-	SAND	.2-	TO	CLAY	BAR
		.05	.002	.002	.0002	1	.5	.25	.10	.05	.02	.002	.002	2-.1	.02	CLAY		TO
CM		(- PCT LT 2MM -)														PCT	PCT	CLAY
000-25	AP		90.4	5.1	4.5		.4	1.2	2.0	64.3	22.5	2.5	2.6		67.9	82.4		.60
025-43	C1CA		88.1	6.0	5.9		.1	.5	1.4	65.8	20.3	2.7	3.3		67.8	83.6		.41
043-56	C2		93.1	4.3	2.6		.4	1.0	1.2	70.3	20.2	2.2	2.1		72.9	87.5		
056-86	C3		91.1	7.2	1.7		.2	.9	1.1	64.8	24.1	2.4	4.8		67.0	89.0		
086-109	C4		93.4	5.2	1.4		TR	.2	.4	63.9	28.8	2.7	2.5		64.5	94.6		
109-140	2C5		51.3	44.8	3.9		.1	.1	.2	1.2	49.7	40.4	4.4		1.6	91.1		
140-157	2C6		52.4	44.2	3.4		.0	.1	.3	1.0	51.0	40.7	3.5		1.4	92.5		

DEPTH	(PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2)(BULK DENSITY)(- - - -WATER CONTENT- - - -)												CARBONATE		(- -PH - -)	
	VOL.	(- - - - - - - WEIGHT - - - - - - -)					4A1G	4A1H	4D1	4B1C	4B1C	4B2	4C1	6E1B	3A1A	8C1A	8C1E
	GT	GT	75-20	20-5	5-2	LT	20-2	1/3-	OVEN	COLE	1/10	1/3-	15-	WRD	LT	LT	1/1	1/2
	2	75				.074	PCT	BAR	DRY		BAR	BAR	BAR	CM/	2	.002	H2O	CACL
CM	PCT	PCT	(- - - PCT LT 75 - - -)				LT2C	G/CC	G/CC		PCT	PCT	PCT	CM	PCT	PCT		
000-25	TR	0	0	0	TR	14	TR	1.60A					2.7		3		8.0	
025-43	TR	0	0	0	TR	17	TR	1.66	1.65		13.9		2.4	.19	7	TR	8.2	
043-56	TR	0	0	TR	TR	11	TR	1.60A					.9		7	TR	8.2	
056-86	TR	0	0	0	TR	13	TR	1.57	1.58	.002	9.3		.7	.14	12	TR	8.3	
086-109	TR	C	0	TR	TR	12	TR	1.52	1.49		12.3		.9	.17	10	TR	8.1	
109-140	TR	C	0	C	TR	93	TR	1.57	1.54		24.4		2.2	.35	23	TR	8.1	
140-157	TR	C	0	C	TR	94	TR						1.9		24	TR	8.0	

DEPTH	(ORGANIC MATTER)			IRON	PHOS	(- -EXTRACTABLE BASES 5B4A- -)					ACTY	AL	(CAT EXCH)		RATIO	RATIO	CA	(BASE SAT)	
	6A1A	6B1A	C/N	6C2A	6S1A	6N2E	604C	6P2A	6Q2A		6H1A	6G1C	5A3A	5A6A	8D1	8C3	5F	5C3	5C1
	CRGN	NITG		EXT	TOTL	CA	MG	NA	K	SUM	BACL	KCL	EXTB	NHAC	NHAC	CA	SAT	EXTB	NHAC
	CARB			FE						EXTB	TEA	EXT	ACTY		TC	TO	NHAC	ACTY	
CM	PCT	PCT		PCT	PCT	(- - - - - - - - - - -MEQ / 100 G- - - - - - - - - - - -)									CLAY	MG	PCT	PCT	PCT	
000-25	.66B						1.6	.2	.1					5.7	1.27				
025-43	.29						1.5	.2	.1					3.5	.59				
043-56	.11						.7	.1	.1					1.8	.69				
056-86	.04						.4	.1	.1					1.2					
086-109	.04						.4	.1	.1					1.3					
109-140	.08						1.1	.2	.1					3.7					
140-157	.07						1.0	.2	.1					3.5					

(A) ESTIMATED.
(B) 4 KG OF CARBON PER SQ METER TO A DEPTH OF 1 METER, METHOD 6A.

Soil classification: Aeric Calciaquoll; sandy, frigid.
Series: Ulen series.
Pedon No.: S67MN54-6.
Area: Norman County, Minnesota.
Location: 130 feet south and 280 feet east of the northwest corner of the NW¼SW¼SW¼ sec. 33, T. 144 N., R. 44 W. (Wild Rice Twp.). That corner is the junction of an east-west line of trees (a windbreak) and a north-south gravel road.
Climate: Some characteristics of temperature in degrees F. are: annual normal - 41, winter normal - 10, summer normal - 68; some characteristics of precipitation in inches are: mean annual - 20, May to September - 14, mean snowfall - 35.
Vegetation: Recently plowed field that was in small grains this summer.
Parent material: Sandy, calcareous, lacustrine sediments associated with glacial Lake Agassiz.
Physiography: Glacial Lake Agassiz plain; site occurs in an interbeach area between the Campbell and Norcross beach ridges.
Topography: Site occurs on the lower part of a very gently undulating knoll. Slope at site is about ½ percent.
Drainage: Moderately well or somewhat poor.
Ground water: At 62 inches.
Erosion: Slight.
Permeability: Moderately rapid.
Moisture: Moist throughout.
Sampled by: R. H. Jordan, G. S. Holmgren, D. D. Barron, and H. R. Finney on October 18, 1967.
Described by: H. R. Finney.

Ap 67L619 0 to 25 cm (0 to 10 inches) Very dark gray (10YR 3/1) light fine sandy loam; weak fine subangular blocky structure parting to weak fine and medium granular structure; friable; roots plentiful; slightly effervescent; abrupt smooth boundary.

Cica 67L620 25 to 43 cm (10 to 17 inches) Dark grayish brown (10YR 4/2) grading to grayish brown (10YR 5/2) heavy loamy fine sand; weak medium subangular blocky structure; very friable; roots plentiful; about 2 percent very dark gray krotovinas; violently effervescent; gradual smooth boundary.

C2 67L621 43 to 56 cm (17 to 22 inches) The base color ranges from light yellowish brown (2.5Y 6/4) to light brownish gray (2.5Y 6/3), the latter color occupying about 40 percent of the faces; fine sand; few fine faint light brownish gray (2.5Y 6/2) mottles; weak medium and coarse subangular blocky structure; very friable; few roots; slightly effervescent; clear wavy boundary.

C3 67L622 56 to 86 cm (22 to 34 inches) Light yellowish brown (2.5Y 6/4) fine sand; many fine faint light brownish gray to gray (2.5Y 6/2 to 2.5Y 6/1) and few fine prominent yellowish red (5YR 4/8) mottles; massive; very friable; no roots; slightly effervescent; clear wavy boundary.

C4 67L623 86 to 109 cm (34 to 43 inches) Reddish yellow (7.5YR 6/8) fine sand; many coarse prominent light gray (5Y 7/1) mottles; massive; firm in place, loose when disturbed; no roots; about 5 percent black soft 1 to 2 mm vertically elongated concretions; the pattern of colors is not uniform throughout, in places in the upper part the light gray color is dominant; about 1 percent soft black and reddish brown rounded concretions in lower part; slightly effervescent; abrupt smooth boundary.

IIC5 67L624 109 to 140 cm (43 to 55 inches) Gray (5Y 6/1) very fine sand; common medium and coarse prominent yellowish brown (10YR 5/6) and few fine prominent yellowish red (5YR 4/8) mottles; massive; firm in place, very friable when removed and disturbed; no roots; slightly effervescent; abrupt smooth boundary.

IIC6 67L625 140 to 157 cm (55 to 62 inches) Light brownish gray (2.5Y 6/2) very fine sand; few medium prominent dark brown (7.5Y 4/4) and a few coarse faint light olive brown (2.5Y 5/4) mottles; massive; firm in place, very friable when removed; no roots; slightly effervescent.

Remarks: Colors are for moist soil. Samples and descriptions were obtained from the pit with the following dimensions, 3 x 10 x 6½ feet in depth. This pedon represents a segment of the series that has a less well developed Cca horizon than the central segment of the series. Soil temperature at 20 inches was 9.0 degrees C. and at 60 inches was 11.5 degrees C.

SOIL CLASSIFICATION-AQUIC UDORTHENT
SANDY OVER LOAMY, MIXED, FRIGID
SERIES - - - - - - -ULEN TAXADJUNCT

SOIL NO - - - - - - S67MN-54-3 COUNTY - - - NORMAN

GENERAL METHODS- - -1A,1B1B,2A1,2B SAMPLE NOS. 67L626-67L631 FEBRUARY 1977

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, NTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

DEPTH CM	HORIZON	SAND 2-.05	SILT .05-.002	CLAY LT .002	FINE CLAY LT .0002	VCOS 2-1	CORS 1-.5	MEDS .5-.25	FNES .25-.10	VFNS .10-.05	COSI .05-.02	FASI .02-.002	VFSI .005-.002	FAML TEXT SAND 2-.1	INTR II .2-.02	FINE CLAY TO CLAY PCT	NON-CO3-CLAY PCT	RATIO 8D1 15-BAR TO CLAY
		(- - - PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B; PCT LT 2MM - - -)																
000-20	A1P	88.4	6.0	5.6		.1	.6	1.0	44.5	42.2	4.0	2.0		46.2	89.0			.54
020-33	B1	92.0	4.1	3.9		.1	.4	.5	50.2	40.9	2.9	1.2		51.1	92.5			.41
033-46	B21	92.9	4.0	3.1		.1	.3	.3	54.3	37.9	3.0	1.0		55.0	94.0			.42
046-64	B22	89.2	7.9	2.9		.1	.1	.1	45.5	43.4	5.4	2.5		45.8	94.1			.39
064-97	B3G	93.9	5.3	.8		.0	.1	.1	41.2	52.5	3.3	2.0		41.4	96.8			
097-152	2C1G	81.9	16.5	1.6		.0	.1	.2	14.7	66.9	14.6	1.9		15.0	95.8			

DEPTH CM	VCL. GT 2 PCT	WEIGHT GT 75 PCT	75-20	20-5	5-2	LT .074	20-2 PCT LT20	BULK DENSITY 4A1G 1/3-BAR G/CC	4A1H OVEN DRY G/CC	4D1 COLE	WATER CONTENT 4B1C 1/10 BAR PCT	4B1C 1/3-BAR PCT	4B2 15-BAR PCT	4C1 WRD CM/CM	CARBONATE 6E1B LT 2 PCT	3A1A LT .002 PCT	PH 8C1A 1/1 H2O	8C1E 1/2 CACL
	(PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2)		(- - - PCT LT 75 - - -)															
000-20	TR	0	0	0	TR	23	TR	1.48	1.52	.009	22.2		3.0	.28	TR		7.2	
020-33	TR	0	0	0	TR	18	TR	1.66	1.66		13.7		1.6	.20	TR		7.6	
033-46	TR	0	0	0	TR	16	TR	1.60	1.59		13.6		1.3	.20	2	TR	7.9	
046-64	TR	0	0	0	TR	23	TR	1.60A					1.1		10	TR	8.1	
064-97	0	0	0	0	0	20	0	1.54	1.50		20.2		.6	.30	11	TR	8.2	
097-152	0	0	0	0	0	48	0	1.56	1.50		22.8		1.1	.34	14	TR	8.1	

DEPTH CM	ORGANIC MATTER 6A1A ORGN CARB PCT	6B1A NITG PCT	C/N	IRON 6C2A EXT FE PCT	PHOS 6S1A TOTL PCT	EXTRACTABLE BASES 5B4A 6N2E CA	6O4C MG	6P2A NA	6Q2A K	SUM EXTB	ACTY 6H1A BACL TEA	AL 6G1D KCL EXT	CAT EXCH 5A3A EXTB ACTY	5A6A NHAC	RATIO 8D1 NHAC TO CLAY	RATIO 8D3 CA TO MG	CA 5F SAT NHAC PCT	BASE SAT 5C3 EXTB ACTY PCT	5C1 NHAC PCT
						(- - - MEQ / 100 G - - -)													
000-20	.84B	.078	11				1.5	.1	.1					9.0	1.61				
020-33	.18	.019	9				.6	.1	.1					1.9	.49				
033-46	.15						.6	.1	.1					2.7	.87				
046-64	.11						.4	.1	.1					2.2	.76				
064-97	.10						.4	.1	.1					1.1					
097-152							.6	.1	.1					2.0					

DEPTH CM	SATURATED PASTE 8E1 REST OHM-CM	8C1B PH	8A H2O PCT	NA 5C2 ESP PCT	NA 5E SAR	SALT 8D5 TOTL SOLL PPM	GYP 6F1A PCT	8A1A EC MMHOS/CM	SATURATION EXTRACT 8I 6N1B CA	6O1B MG	6P1A NA	6Q1A K	6I1A CO3	6J1A HCO3	6K1A CL	6L1A SO4	6M1A NO3	ATTERBERG 4F1 LQID LMIT PCT	4F2 PLST INDX
									(- - - MEQ / LITER - - -)										
000-20																			
020-33																			
033-46																			
046-64																			
064-97	8500	8.2	24.9			80		.53											
097-152																			

(A) ESTIMATED.
(B) 4 KG OF CARBON PER SQ METER TO A DEPTH OF 1 METER, METHOD 6A.

Pedon classification: Aquic Udorthent; sandy over loamy, mixed, frigid.
Series classification: Aeric Calciaquolls; sandy, frigid.
Series: Ulen taxadjunct.
Pedon No.: S67MN-54-3.
Area: Norman County, Minnesota
Location: NW¼NW¼NE¼ sec. 18, T. 144 N., R. 44 W. (Wild Rice Twp.).
Climate: Some characteristics of temperature in degrees F. are: annual normal - 41, winter normal - 10, summer normal - 68; some characteristics of precipitation in inches are: mean annual - 20, May to September - 14, mean snowfall - 35.
Vegetation: Recently plowed alfalfa field.
Parent material: Sandy lacustrine sediments associated with glacial Lake Agassiz.
Physiography: Glacial Lake Agassiz plain; site occurs between the Campbell and Norcross beach ridges.
Topography: Sample site occurs on a very gently sloping knoll; the knoll is about 10 acres in size; slope at site is about ½ percent and it occurs near the crest of the slope.
Drainage: Moderately well or somewhat poorly drained.
Ground water: At 64 inches.
Erosion: Slight to moderate.
Permeability: Rapid to moderately rapid.
Moisture: Moist throughout.
Sampled by: R. H. Jordan, G. S. Holmgren, D. D. Barron and H. R. Finney.
Described by: H. R. Finney.

Alp 67L626 0 to 20 cm (0 to 8 inches) Very dark gray to very dark brown (10YR 3/1 to 10YR 2/2) loamy fine sand, weak fine subangular blocky structure; very friable; roots abundant; about 5 percent medium inclusions of dark grayish brown and yellowish brown (10YR 4/2 and 10YR 5/4); thickness varies from 7 to 10 inches in the pit; noneffervescent; abrupt wavy boundary.

B1 67L627 20 to 33 cm (8 to 13 inches) Yellowish brown (10YR 5/4) fine sand; few medium faint dark grayish brown (10YR 4/2) mottles; weak medium and coarse subangular blocky structure; very friable; roots plentiful; noneffervescent; clear smooth boundary.

B21 67L628 33 to 46 cm (13 to 18 inches) Olive yellow (2.5Y 6/6) grading to brownish yellow (10YR 6/6) fine sand; few fine faint light yellowish brown (2.5Y 6/4) mottles; massive; loose; few roots; slightly effervescent; clear smooth boundary.

B22 67L629 46 to 64 cm (18 to 25 inches) Olive yellow (2.5Y 6/6) fine sand; few fine faint brownish yellow (10YR 6/6) mottles; massive; loose; few roots; slightly effervescent; clear smooth boundary.

B3g 67L630 64 to 97 cm (25 to 38 inches) Light brownish gray and light gray (2.5Y 6/2 and 2.5Y 7/2) fine sand; few medium faint light yellowish brown (2.5Y 6/4) mottles; massive; loose; few roots; about 1 percent 1 to 2 mm soft black concretions and about 0.5 percent soft yellowish red concretions; slightly effervescent; gradual smooth boundary.

IIClg 67L631 97 to 152 cm (38 to 60 inches) Light brownish gray to light gray (2.5Y 6/2 to 2.5Y 6/1) very fine sand; many coarse distinct light olive brown (2.5Y 5/4) and common fine prominent strong brown (7.5YR 5/6) mottles; massive; loose; no roots; about 2 percent 0.5 to 1 mm soft black concretions occurring mainly in the 2.5Y 6/2 and 6/1 parts; slightly effervescent.

Remarks: Colors are for moist soil. Soil temperature at 60 inches was 12 degrees C. and at 20 inches was 9.5 degrees C. Samples and descriptions were obtained from a pit with dimensions of about 3 x 10 x 7 feet in depth. Ten holes were dug within a radius of 50 feet of the sampling site to determine the thickness of the mollic epipedon. The depths in inches follow: 12, 13, 10, 14, 11, 8, 11, 9, 10, and 12 giving an average depth of 10.9 inches. This pedon presently is undefined at the series category. It probably would be considered as a taxadjunct of the Flaming series or possibly the Ulen series.

SOIL CLASSIFICATION-TYPIC HAPLAQUOLL
FINE, MONTMORILLONITIC, MESIC
SERIES - - - - - - -WALDORF

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, NTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

SOIL NO - - - - - - S69MN-7-6 COUNTY - - - BLUE EARTH

GENERAL METHODS- - -1A, 1B1B, 2A1, 2B

SAMPLE NOS. 69L797-69L805 (A) JULY 1976
69L913-69L921

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B														RATIO
		SAND 2- .05	SILT .05- .002	CLAY LT .002	FINE CLAY LT .0002	SAND VCOS 2- 1	SAND CORS 1- .5	SAND MEDS .5- .25	SAND FNES .25- .10	SAND VFNS .10- .05	SILT COSI .05 .02	SILT FNSI .02 .002	SILT VFSI .002- .002	FAML TEXT SAND 2-.1	INTR II .2- .02	FINE CLAY TO CLAY	NON- COS- CLAY	8D1 15- BAR TO CLAY
CM		PCT LT 2MM														PCT	PCT	
000-18	AP	5.7	41.6	52.7	33.6	0.2	0.6	0.7	1.8	2.4	11.4	30.2	12.4	3.3	14.9	64		0.44
018-28	A12	6.6	41.9	51.5	31.3	0.5	0.7	0.9	2.0	2.5	10.6	31.3		4.1	14.4	61		0.47
028-43	A3	4.0	38.9	57.1	38.3	0.4	0.2	0.5	1.3	1.6	8.7	30.2	15.0	2.4	11.1	67		0.44
043-56	B1G	3.8	36.4	59.8	32.0	0.4	0.7	0.5	1.0	1.2	5.3	31.1	15.5	2.6	7.1	54		0.42
056-69	B2G	2.9	34.1	63.0	33.4	0.2	0.4	0.5	0.9	1.0	3.8	30.3		1.9	5.3	53		0.40
069-81	B3G	2.5	35.9	61.6	27.2	0.1	0.4	0.4	0.7	0.9	4.8	31.1		1.6	6.1	44		0.41
081-97	C1G	1.7	47.4	50.9	17.4	0.1	0.4	0.3	0.6	0.4	0.7	46.7	27.7	1.3	1.5	34		0.43
097-125	C2G	1.6	47.3	51.1	19.6	0.1	0.3	0.4	0.5	0.3	1.8	45.5		1.3	1.9	38		0.42
125-166	2C3	16.2	49.4	34.4	12.7	0.7	1.5	2.3	6.4	5.3	10.1	39.3		10.9	19.6	37		0.47

DEPTH	PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2 VOL. GT 2	WEIGHT GT 2	WEIGHT 75-20	WEIGHT 20-5	WEIGHT 5-2	WEIGHT LT .074	WEIGHT 20-2	BULK DENSITY 4A1D 1/3- BAR	BULK DENSITY 4A1H OVEN DRY	4D1 COLE	WATER CONTENT 4B1C 1/10 BAR	WATER CONTENT 4B1C 1/3- BAR	WATER CONTENT 4B2 15- BAR	WATER CONTENT 4C1 WRD CM/ CM	CARBONATE 6E1B LT 2	CARBONATE 3A1A LT .002	PH 8C1A 1/1 H2O	PH 8C1E 1/2 CACL
CM	PCT	PCT	PCT LT 75				LT20	G/CC	G/CC		PCT	PCT	PCT	CM	PCT	PCT		
000-18	TR	0	0	0	TR	96		1.16	1.75	.147	45.5	42.2	23.2	.22			6.3	
018-28	TR	0	0	0	TR	95		1.15	1.72	.144	42.6	39.6	24.1	.18			6.1	
028-43	TR	0	0	0	TR	97		1.14	1.77	.158	41.9	40.6	25.2	.18			6.6	
043-56	TR	0	0	0	TR	97		1.13	1.79	.166	42.7	42.9	25.0	.20			6.8	
056-69	TR	0	0	0	TR	98		1.20	1.77	.138	37.8	36.3	25.2	.13	2		7.3	
069-81	TR	0	0	0	TR	98		1.22	1.69	.115	36.7	34.8	25.2	.12	4		7.6	
081-97	TR	0	0	0	TR	99		1.21	1.55	.086	39.3	37.3	22.1	.18	16		7.6	
097-125	TR	0	0	0	TR	99		1.22	1.53	.078	41.6	40.0	21.3	.23	17		7.6	
125-166	TR	0	0	1	1	86		1.30	1.42	.030	37.8	36.3	16.2	.26	16		7.8	

DEPTH	ORGANIC MATTER 6A1A ORGN CARB	6B1A NITG	C/N	IRON 6C2B EXT FE	PHOS 6S1A TOTL	EXTRACTABLE BASES 5B4A- 6N2E CA	6O2D MG	6P2B NA	6Q2B K	SUM EXTB	ACTY 6H2A BACL TEA EXT	AL 6G1D KCL EXT	CAT EXCH 5A3A EXTB ACTY	5A6A NHAC	RATIO 8D1 NHAC TO CLAY	RATIO 8D3 CA TO MG	CA SAT NHAC	BASE SAT 5C3 EXTB ACTY	BASE SAT 5C1 NHAC
CM	PCT	PCT		PCT	PCT	MEQ / 100 G											PCT	PCT	PCT
000-18	3.81B	0.325	12	0.5		42.8	10.4	0.2	0.6	54.0	8.3		62.3	49.2	0.93	4.1	87	87	110
018-28	4.20	0.330	13	0.5		43.1	11.0	0.2	0.6	54.9	8.6		63.5	50.3	0.98	3.9	86	86	109
028-43	1.47	0.162	9	0.6		41.0	11.6	0.2	0.5	53.3	5.8		59.1	48.4	0.85	3.5	85	90	110
043-56	0.95	0.082	12	0.6		39.2	12.4	0.2	0.5	52.3	5.0		57.3	47.8	0.80	3.2	82	91	109
056-69	0.80			0.7				0.3	0.5					46.8	0.74				
069-81	0.54			0.9				0.3	0.5					44.2	0.72				
081-97	0.39			0.5				0.3	0.5					32.6	0.64				
097-125	0.39			0.5				0.4	0.5					28.5	0.56				
125-166	0.38			0.8				0.4	0.4					20.0	0.98				

DEPTH	SATURATED PASTE 8E1 REST OHM-	8C1B PH	8A H2O	NA 5D2 ESP	NA 5E SAR	SALT 8D5 TOTL SOLU	GYP 6F1A	SATURATION EXTRACT 8A1- 8A1A EC	6N1B CA	6O1B MG	6P1A NA	6Q1A K	6I1A CO3	6J1A MCO3	6K1A CL	6L1A SO4	6M1A NO3	ATTERBERG 4F1 LQID LMIT	4F2 PLST INDX
CM	CM		PCT	PCT		PPM	PCT	MMHOS/ CM	MEQ / LITER									PCT	
000-18																			
018-28																			
028-43																			
043-56																		85C	49
056-69																			
069-81																			
081-97	2000	7.4																72C	41
097-125	2000	7.4																	
125-166		7.5																	

ANALYSES BY MINNESOTA AGRICULTURAL EXPERIMENT STATION, ST PAUL, MN. MINERALOGY BY X-RAY ANALYSIS. TOTAL PHOSPHORUS BY NITRIC-PERCHLORIC DIGESTION. AVAILABLE PHOSPHORUS BY BRAY'S NO 1 EXTRACTANT.

DEPTH	MINERALOGY MONT	VERM	ILLITE	KAOL	QUARTZ	TOTAL P	AVAIL P
	PCT LT .002MM					LBS/A	
000-18	65	0	20	10	5	1460	23
018-28							18
028-43						688	4
043-56	75		10	5	5		3
056-69						806	3
069-81							2
081-97	85	0	10	5	0		2
097-125						1128	1
125-166							2

(A) BULK DENSITY AND WATER CONTENT ANALYSES BY THE SOIL SURVEY INVESTIGATIONS UNIT, LINCOLN, NE. UNLESS OTHERWISE INDICATED REMAINING ANALYSES BY THE SOIL SURVEY INVESTIGATIONS UNIT, BELTSVILLE, MD.
(B) ORGANIC CARBON IS 20 KG/M SQ TO A DEPTH OF 1 M (6A).
(C) LL AND PI BY SOIL MECHANICS LAB, USDA-SCS, LINCOLN, NE.

Pedon classification: Typic Haplaquoll; fine, montmorillonitic, mesic.
Series classification: Same.
Soil: Waldorf series.
Soil No.: S69MN-7-6.
Location: Blue Earth County, Minnesota; NE1/4 of SW1/4, Sec. 26, T. 105 N., R. 27 W. (Sterling Twp.); about 360 feet west and 100 feet south of northeast corner of SW1/4, Sec. 26. About 94 deg. 2 min. west longitude and 43 deg. 53 min. north latitude.
Climate: Humid continental. Some characteristics of temperature in deg. F. are: annual normal - 46, winter normal - 17, summer normal - 71; some characteristics of precipitation in inches are: annual normal - 28, May through September - 18, normal annual snowfall - 40.
Parent material: Moderately deep, fine textured lacustrine sediments over grayish, calcareous, loamy glacial till (New Ulm) of the Des Moines Lobe, Late Wisconsin age.
Physiography: Central Lowlands; glacial Lake Minnesota Plain in the Blue Earth Till Plain of H. E. Wright (1972).
Landscape setting: About 1/2 percent, slightly concave slope. General topography is nearly level to very gently undulating. Relative relief in the immediate vicinity is about 5 feet. Elevation of site is 1,025 feet. Major associated soils on the landscape near this site are of the Lura and Collinwood series.
Vegetation: Recently plowed oat field; native vegetation was tall grass prairie.
Drainage: Poorly drained.
Erosion: Slight.
Permeability: Slow in upper part, moderate in the glacial till.
Described by: R. J. Edwards and H. R. Finney on October 22, 1969.
Sampled by: L. Shields, R. H. Rust, R. J. Edwards, J. F. Cummins, J. J. Murray, and H. R. Finney on October 22, 1969.

Ap 69B797 0 to 18 cm (0 to 7 inches) Black (N 2/) silty clay; weak to moderate very fine and fine subangular blocky structure; firm, plastic and sticky; abrupt smooth boundary.

A12 69B798 18 to 28 cm (7 to 11 inches) Black (N 2/) silty clay; moderate very fine subangular blocky structure; firm, plastic and sticky; clear smooth boundary.

A3 69B799 28 to 43 cm (11 to 17 inches) Black (10YR 2/1) and very dark gray (10YR 3/1) silty clay; moderate very fine subangular and angular blocky structure; very firm, plastic and sticky; clear smooth boundary.

B1g 69B800 43 to 56 cm (17 to 22 inches) Very dark gray (5Y 3/1) and dark gray (5Y 4/1) clay; weak fine and medium prismatic structure parting to moderate very fine subangular and angular blocky structure; very firm, plastic and sticky; clear smooth boundary.

B2g 69B801 56 to 69 cm (22 to 27 inches) Dark gray (5Y 4/1) clay; common fine faint olive gray (5Y 4/2) mottles; weak to moderate fine and medium prismatic structure parting to moderate to strong very fine angular blocky structure; very firm, plastic and sticky; few thin tongues of very dark gray (5Y 3/1) 5 to 10 cm apart; clear smooth boundary.

B3g 69B802 69 to 81 cm (27 to 32 inches) Olive gray (5Y 4/2) clay; few fine faint olive (5Y 5/3) mottles; weak to moderate fine and medium prismatic structure parting to moderate to strong very fine and fine angular blocky structure; very firm, plastic and sticky; few thin very dark gray (5Y 3/1) and dark gray (5Y 4/1) tongues; clear smooth boundary.

C1g 69B803 81 to 97 cm (32 to 38 inches) Olive gray (5Y 5/2) light silty clay; common fine distinct olive (5Y 5/4 and 5Y 5/6) mottles; weak medium prismatic structure parting to moderate very fine subangular blocky structure; firm, plastic and sticky; few thin very dark gray (5Y 3/1) and dark gray (5Y 4/1) tongues; slightly effervescent; clear smooth boundary.

C2g 69B804 97 to 125 cm (38 to 49 inches) Olive gray (5Y 5/2) silty clay; common fine prominent light olive brown (2.5Y 5/4 and 2.5Y 5/6) mottles; weak medium and coarse prismatic structure parting to weak very fine and fine subangular blocky structure; firm, plastic and sticky; few lime pebbles; about 5 percent soft lime masses; few streaks of light gray (5Y 7/2) segregated lime; strongly effervescent; clear smooth boundary.

IIC3 69B805 125 to 166 cm (49 to 65 inches) Olive gray (5Y 5/2) clay loam or silty clay loam; many fine prominent light olive brown (2.5Y 5/4 and 2.5Y 5/6) mottles; weak fine and medium subangular blocky structure; friable, slightly plastic to plastic; about 2 percent coarse fragments; few masses of light gray (5Y 7/2) segregated lime; strongly effervescent.

Remarks: Colors are for moist soil. These samples were obtained from a pit with approximate dimensions of 1 x 3 x 2 m in depth. This pedon is representative of the middle segment of the

SOIL CLASSIFICATION-TYPIC HAPLAQUOLL
FINE, MONTMORILLONITIC, MESIC
SERIES - - - - - - -WALDORF

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, NTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

SOIL NO - - - - - - S69MN-7-8 COUNTY - - - BLUE EARTH

GENERAL METHODS- - -1A, 1B1B, 2A1, 2B SAMPLE NOS. 69B811-69B819 (A) JULY 1976
69L952-69L960

DEPTH	HORIZON	PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B															RATIO
		SAND 2- .05	SILT .05- .002	CLAY LT .002	FINE CLAY LT .0002	SAND VCOS 2- 1	SAND CORS 1- .5	SAND MEDS .5- .25	SAND FNES .25- .10	SAND VFNS .10- .05	SILT COSI .05 .02	SILT FNSI .02 .002	SILT VFSI .005- .002	FAML TEXT SAND 2-.1	INTR II .2- .02	FINE CLAY TO CLAY	NON- CO3- CLAY	8D1 15- BAR
CM		PCT LT 2MM														PCT	PCT	TO CLAY
000-23	AP	7.7	53.2	39.1	24.3	0.2	0.4	0.6	2.1	4.4	15.3	37.9	9.6	3.3	21.1	62		0.47
023-38	A12	7.4	52.8	39.8	25.8	0.2	0.4	0.7	2.1	4.1	12.5	40.3		3.3	18.0	65		0.47
038-51	B1G	8.2	56.4	35.4	22.4	0.3	0.6	0.6	2.1	4.6	16.3	40.1	9.8	3.6	22.3	63		0.45
051-71	B2G	7.0	61.2	31.8	21.9	0.1	0.4	0.9	2.3	3.3	34.3	26.9		3.7	39.1	69		0.62
071-88	B31G	4.7	38.1	57.2	36.0	0.1	0.4	0.6	1.6	2.0	8.5	29.6		2.7	11.5	63		0.43
088-114	B32G	4.2	41.4	54.4	30.8	0.3	0.4	0.5	1.4	1.6	3.8	37.6		2.6	6.3	57		0.44
114-135	C1G	5.0	46.8	48.2	26.7	0.1	0.5	0.7	2.0	1.8	5.3	41.5		3.2	8.4	55		0.48
135-158	C2G	8.4	52.4	39.2	14.5	0.4	1.1	1.6	3.0	2.3	11.7	40.7		6.1	15.6	37		0.31
158-183	C3G	11.2	49.8	39.0	17.1	0.6	1.1	1.6	4.6	3.3	4.6	45.2		7.9	10.8	44		0.51

DEPTH	PARTICLE SIZE ANALYSIS, MM, 3B, 3B1, 3B2 VOL.	WEIGHT GT 2	WEIGHT GT 75	WEIGHT 75-20	WEIGHT 20-5	WEIGHT 5-2	WEIGHT LT .074	WEIGHT 20-2	BULK DENSITY 4A1D 1/3-BAR	BULK DENSITY 4A1H OVEN DRY	BULK DENSITY 4D1 COLE	WATER CONTENT 4B1C 1/10 BAR	WATER CONTENT 4B1C 1/3-BAR	WATER CONTENT 4B2 15-BAR	WATER CONTENT 4C1 WRD CM/CM	CARBONATE 6E1B LT 2	CARBONATE 3A1A LT .002	PH 8C1A 1/1 H2O	PH 8C1E 1/2 CACL
CM		PCT	PCT	PCT LT 75				LT20	G/CC	G/CC		PCT	PCT	PCT		PCT	PCT		
000-23	TR	0	0	0	0	TR	96		1.28	1.60	.077	30.4	29.2	18.5	.14	1.98		6.4	
023-38	TR	0	0	0	0	TR	96		1.29	1.60	.075	37.0	34.6	18.9	.20			6.5	
038-51	TR	0	0	0	0	TR	95		1.31	1.53	.053	33.6	31.1	16.0	.20	1.38		6.5	
051-71	TR	0	0	0	0	TR	95		1.29	1.78	.113	35.2	34.8	19.6	.20	1.38		6.4	
071-88	TR	0	0	0	0	TR	97		1.28	1.64	.086	39.8	37.6	24.5	.17	0.98		6.9	
088-114	TR	0	0	0	0	TR	97		1.27	1.88	.140	39.0	38.2	23.8	.18			6.9	
114-135	TR	0	0	0	0	TR	96		1.31	1.76	.104	35.8	35.3	23.2	.16			6.9	
135-158	TR	0	0	0	0	TR	94		1.28	1.59	.075	37.8	36.1	20.0	.21		5	7.4	
158-183	TR	0	0	0	0	TR	91		1.30	1.56	.063	37.6	35.6	19.7	.21	2.38	10	7.6	

DEPTH	ORGANIC MATTER 6A1A ORGN CARB	6B1A NITG	C/N	IRON 6C2B EXT FE	PHOS 6S1A TOTL	EXTRACTABLE BASES 5B4A- 6N2E CA	6O2D MG	6P2B NA	6Q2B K	SUM EXTB	ACTY 6H2A BACL TEA	AL 6G1D KCL EXT	CAT EXCH 5A3A EXTB ACTY	5A6A NHAC	RATIO 8D1 NHAC TO CLAY	RATIO 8D3 CA TO MG	CA SAT NHAC	BASE SAT 5C3 EXTB ACTY	5C1 NHAC
CM	PCT	PCT		PCT	PCT	MEQ / 100 G											PCT	PCT	PCT
000-23	3.77C	0.280	13																
023-38	3.23	0.239	14																
038-51	1.53	0.121	13																
051-71	0.89	0.072	12																
071-88	0.40																		
088-114	0.27																		
114-135	0.23																		
135-158	0.23																		
158-183	0.16																		

DEPTH	SATURATED PASTE 8E1 REST OHM-	8C1B PH	8A H2O	NA 5D2 ESP	NA 5E SAR	SALT 8D5 TOTL SOLU	GYP 6F1A	SATURATION EXTRACT 8A1- 8A1A EC	6N1B CA	6O1B MG	6P1A NA	6Q1A K	6I1A CO3	6J1A HCO3	6K1A CL	6L1A SO4	6M1A NO3	ATTERBERG 4F1 LQID LMIT	4F2 PLST INDX
CM	CM		PCT	PCT		PPM	PCT	MMHOS/ CM	MEQ / LITER									PCT	
000-23																			
023-38																			
038-51																			
051-71																			
071-88																			
088-114	1000	6.9																	
114-135	2000	7.1																	
135-158	2000	7.4																	
158-183	2000	7.4																	

ANALYSES BY MINNESOTA AGRICULTURAL EXPERIMENT STATION, ST PAUL, MN. MINERALOGY BY X-RAY ANALYSIS. TOTAL PHOSPHORUS BY NITRIC-PERCHLORIC DIGESTION. AVAILABLE PHOSPHORUS BY BRAY'S NO 1 EXTRACTANT.

DEPTH	MINERALOGY MONT	VERM	ILLITE	KAOL	QUARTZ	TOTAL P	AVAIL P
	PCT LT .002MM					LBS/A	
000-23	70	0	20	5	5	1244	87
023-38							71
038-51	70	0	20	10	0		11
051-71						648	4
071-88							4
088-114						950	3
114-135							10
135-158						1310	23
158-183							22

(A) BULK DENSITY AND WATER CONTENT ANALYSES BY THE SOIL SURVEY INVESTIGATIONS UNIT, LINCOLN, NE. UNLESS OTHERWISE INDICATED REMAINING ANALYSES BY THE SOIL SURVEY INVESTIGATIONS UNIT, BELTSVILLE, MD.

(B) MICRO-PENETRATION RESISTANCE - A ROD 0.6 CM DIA IS SLOWLY PUSHED INTO BULK DENSITY CLOD, EQUILIBRATED AT 1/10-BAR, A DISTANCE OF 0.6 CM USING A POCKET PENETROMETER. UNITS ARE FORCE (KG) AND NOT ESTIMATES OF UNCONFINED COMPRESSIVE STRENGTH.

(C) ORGANIC CARBON IS 24 KG/M SQ TO A DEPTH OF 1 M (6A).

Pedon classification: Typic Haplaquoll; fine, montmorillonitic, mesic.
Series classification: Same.
Soil: Waldorf series.
Soil No.: S69 MN-7-8.
Location: Blue Earth County, Minnesota: SW1/4 of SW1/4, Sec. 27, T. 106 N., R. 29 W. (Ceresco Twp.);

SOIL CLASSIFICATION-TYPIC SPHAGNOFIBRIST
DYSIC, FRIGID
SERIES - - - - - - -WASKISH

SOIL NO - - - - - - S73MN-69-2 COUNTY - - - ST. LOUIS

GENERAL METHODS- - -1A,1B1E,2A1,2B SAMPLE NOS. 73L616-73L622 MARCH 1977

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, MTSC
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

DEPTH	HCRIZON		PARTICLE SIZE ANALYSIS, LT 2MM, 3A1, 3A1A, 3A1B														RATIO
					FINE	SAND						SILT			FRAG	INTR	FINE	NON-	8D1
			SAND	SILT	CLAY	CLAY	VCOS	CORS	MEDS	FNES	VFNS	COSI	FNSI	VFSI	TEXT	II	CLAY	CO3-	15-
			2-	.05-	LT	LT	2-	1-	.5-	.25-	.10-	.05	.02	.005-	SAND	.2-	TO	CLAY	BAR
			.05	.002	.002	.0002	1	.5	.25	.10	.05	.02	.002	.002	2-.1	.02	CLAY		TO
CM			PCT LT 2MM														PCT	PCT	CLAY
23-112	OI3																		
112-118	OA2																		
118-223	OI4																		
244-508	OE3	(A)																	
508-559	OI5																		

DEPTH	HISTOSOL CHARACTERIZATION														SHEAR STRENGTH
	(STATE OF DECOMPOSITION)			PH	(BULK DEN)		COLE	SUBS	(- -WATER CONTENT- -)						
	8F	8G		8H	8C1E	4A3A	4A1I	4D1		4B4	4B1C	4B2	4C1		
	MINL	(FIBER	VOL)	PYROPHOSPHT	.01M	FILD	1/3B	RE-	RES-	FILD	1/3B	15-	WRD		(B)
	CONT	UNRB	RUB	SOLUBILITY	CACL	STAT	REWT	WET	IDUE	STAT	REWT	BAR	CM/		
CM	PCT	PCT	PCT			G/CC	G/CC		PCT	PCT	PCT	PCT	CM		KPA
23-112	2	84	80	10YR 7/3	2.8	.07			38	1130					5.4
112-118	2	92	80	10YR 7/3	2.8	.06			30	1470					
118-223	2	58	42	10YR 7/3	3.0	.07			38	1150					7.5
244-508	8	59	39	10YR 7/3	4.0	.11			52	895					7.0
508-559	8	65	32	10YR 7/2	5.0	.11			58	809					9.2

(A) RESULTS FOR 73L619, 73L620, 73L621 AVERAGED AND REPORTED FOR OE3 HORIZON.
(B) KPA = KILOPASCAL.

Pedon classification: Typic Sphagnofibrist; dysic, frigid
Series classification: Same.
Soil: Waskish series.
Soil No.: S73MN-69-2 (MAES-CFC No. 1481)

Location: St. Louis County, Minnesota; about 9 miles east of Floodwood; about 100 feet north of the southeast corner of Sec. 3, T. 51 N., R. 19 W.; about 46.9 deg. north latitude and 92.8 deg. west longitude.

Climate: Humid continental. Mean annual temperature is 39 deg.F.; mean summer temperature is 64 deg.F.; and mean winter temperature is 11 deg.F. Mean annual precipitation is 28 inches; May through September precipitation is 18 inches; mean annual snowfall is 60 inches. Frost-free period

Parent material: Organic soil material derived primarily from sphagnum moss and herbaceous plants over limnic materials over loamy glacial lacustrine sediments of Late Wisconsin age.

Physiography: Central lowlands; Upham Lacustrine Plain. Site is about 2 miles north of the boundary between this lake plain and the Highland Moraine. The lake plain is level. Elevation is about 1,325 feet. Site is near the crest of a raised bog.

Vegetation: Black s ruce forest with about 90 percent crown cover; understory consists of small black spruce, labrador tea, blueberry, and lingonberry; sphagnum mosses cover about 70 percent of the ground surface and hypnum mosses cover the remaining surface.

Size of bog: About 15 square miles; raised portion is about 1 square mile.

Distance to adjacent mineral land: About 2 miles

Microrelief: Hummocky; hummocks of sphagnum and hypnum mosses extend as much as 20 inches above general surface.

Depth to water table: About 10 inches.

Subsidence: Slight; roadside ditch about 100 feet south of the site.

Observers: The upper 575 cm described by H. R. Finney and R. S. Farnham on Sept. 18, 1969. The remaining portion of pedon was described, samples collected, and shear strength measured on July 11, 1973 by E. L. Bruns, J. H. Day, L. Dunnigan, R. S. Farnham, H. R. Finney, M. Levesque, W. C. Lynn, and W. E. McKinzie. Samples were obtained with Macauly peat sampler.

Oi1 0 to 5 cm Dark yellowish brown (10YR 4/4, broken face) fibric material, light gray (10YR 7/1, rubbed and pressed); about 95 percent fiber, about 90 percent rubbed; massive; nonsticky; sphagnum moss fiber; about 5 percent woody fragments; about 5 percent mineral material; clear wavy boundary.

Oe1 5 to 13 cm Dark reddish brown (5YR 2/2, broken face, rubbed, and pressed) hemic material; about 40 percent fiber, about 20 percent rubbed; massive; nonsticky; mostly herbaceous fiber with about 10 percent woody fiber; about 10 percent mineral material, abrupt wavy boundary.

Oi2 13 to 17 cm Dark brown (7.5YR 4/4, broken face) fibric material, pale brown (10YR 6/3, rubbed), dark yellowish brown (10YR 4/4, pressed); about 90 percent fiber, about 70 percent rubbed; massive; nonsticky; sphagnum moss fiber; about 5 percent woody fragments; about 5 percent mineral material; clear wavy boundary.

Oa1 17 to 23 cm Very dark brown (10YR 2/2, broken face, rubbed, and pressed) sapric material; about 30 percent fiber, about 15 percent rubbed; massive; slightly sticky; mixed sphagnum moss, herbaceous, and woody fiber; about 15 percent mineral material; clear wavy boundary.

Oi3 731616 23 to 112 cm Dark brown (7.5YR 4/4, broken face) fibric material, brown (7.5YR 5/4, rubbed and pressed); about 95 percent fiber, about 90 percent rubbed; massive; nonsticky; sphagnum moss

Pedon classification: Typic Sphagnofibrist; dysic, frigid.
Series classification: Same.
Soil: Waskish series.
Soil No.: S73MN-69-2. (MAES-CFC No. 1481).
Location: St. Louis County, Minnesota; about 9 miles east of Floodwood; about 100 feet north of the southeast corner of Sec. 3, T. 51 N., R. 19 W.; about 46.9 deg. north latitude and 92.8 deg. west longitude.
Climate: Humid continental. Mean annual temperature is 39 deg. F.; mean summer temperature is 64 deg. F.; and mean winter temperature is 11 deg. F. Mean annual precipitation is 28 inches; May through September precipitation is 18 inches, mean annual snowfall is 60 inches. Frost-free period is 84 days.
Parent material: Organic soil material derived primarily from sphagnum moss and herbaceous plants over limnic materials over loamy glacial lacustrine sediments of Late Wisconsin age.
Physiography: Central lowlands; Upham Lacustrine Plain. Site is about 2 miles north of the boundary between this lake plain and the Highland Moraine. The lake plain is level. Elevation is about 1,325 feet. Site is near the crest of a raised bog.
Vegetation: Black spruce forest with about 90 percent crown cover; understory consists of small black spruce, labrador tea, blueberry, and lingonberry; sphagnum mosses cover about 70 percent of the ground surface and hypnum mosses cover the remaining surface.
Size of bog: About 15 square miles; raised portion is about 1 square mile.
Distance to adjacent mineral land: About 2 miles.
Microrelief: Hummocky; hummocks of sphagnum and hypnum mosses extend as much as 20 inches above general surface.
Depth to water table: About 10 inches.
Subsidence: Slight, roadside ditch about 100 feet south of the site.
Observers: The upper 575 cm described by H. R. Finney and R. S. Farnham on Sept. 18, 1969. The remaining portion of pedon was described, samples collected, and shear strength measured on July 11, 1973 by E. L. Bruns, J. H. Day, L. Dunnigan, R. S. Farnham, H. R. Finney, M. Levesque, W. C. Lynn, and W. E. McKinzie. Samples were obtained with Macauly peat sampler.

Oe2 223 to 244 cm Dark brown (7.5YR 3/2, broken face, rubbed and pressed) hemic material; about 40 percent fiber, about 20 percent rubbed; massive; nonsticky; herbaceous fiber with about 2 percent woody fiber and fragments; about 10 percent mineral material; clear boundary.

Oe3 (73L619, 73L620, 73L621) 244 to 508 cm Dark brown (7.5YR 3/2, broken face) matrix and strong brown (7.5 YR 5/6, broken face) fiber, dark brown (7.5 YR 3/2, rubbed and pressed); about 60 percent fiber, about 30 percent rubbed; massive; nonsticky; mostly herbaceous fiber with about 3 percent woody fiber and fragments; about 8 percent mineral material; clear boundary.

Oi5 73L622 508 to 559 cm Dark brown (7.5YR 4/4, broken face and rubbed) fibric material, brown (7.5YR 5/4, pressed); about 80 percent fiber, about 60 percent rubbed; massive; nonsticky; about 80 percent herbaceous fiber and about 20 percent hypnum moss fiber; about 5 percent mineral material; pH 5.3; clear boundary.

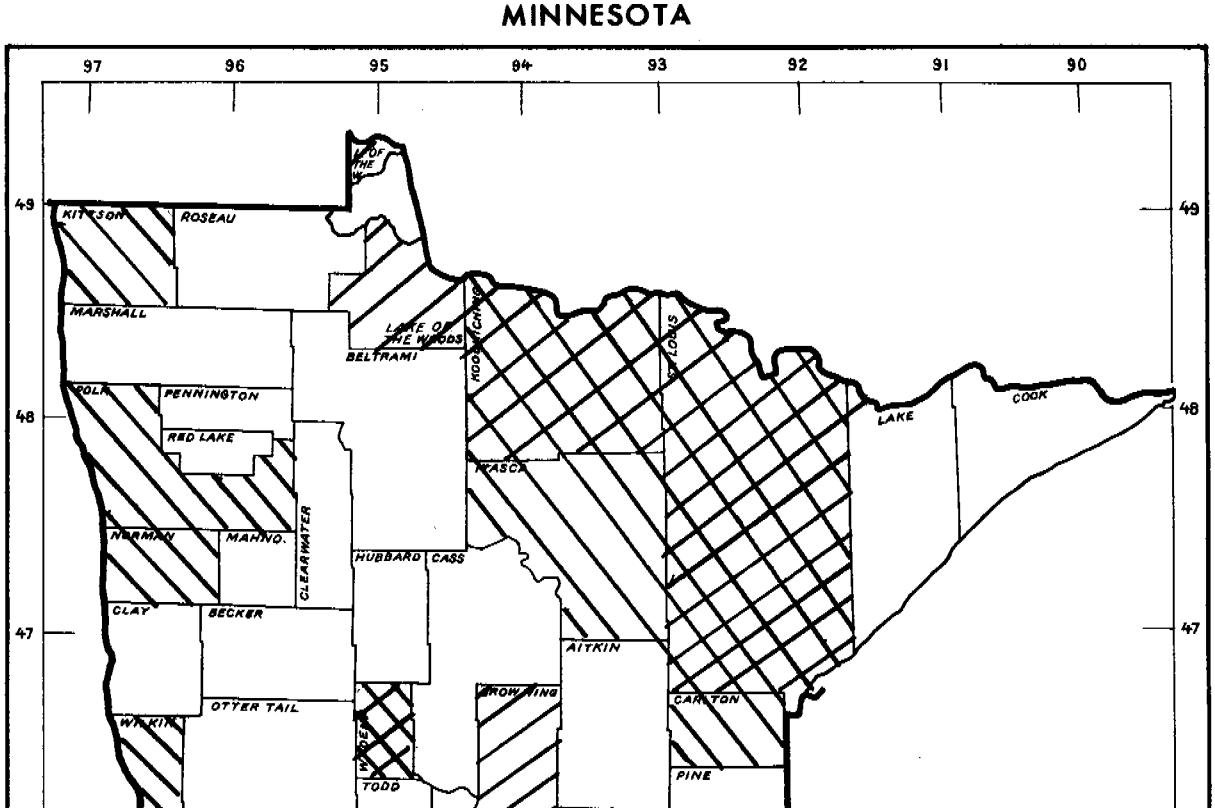
Lco 559 to 575 cm Dark grayish brown (2.5Y 4/2, broken face, rubbed, and pressed) coprogenous earth; about 10 percent herbaceous detritus; massive; nonsticky; about 60 percent mineral material; pH 7.0; gradual boundary.

IICIg (not sampled) 575 to 585 cm Dark gray (5Y 4/1) silt loam; massive; slightly sticky; noncalcareous; clean smooth boundary.

IIC2g (not sampled) 585 to 595 cm Dark gray (5Y 4/1) loam high in content of very fine sand; massive;

Remarks: This pedon is in the central concept of the Waskish series. Shear strength was measured in the following zones: 58-83, 160-185, 250-275, 350-375, 450-475, 520-545 cm. Also, duplicate bulk samples and duplicate samples of known volume were collected at those depths and also at depths of 105-130 cm.

MINNESOTA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KITTSON
ROSEAU
MARSHALL
POLK
PENNINGTON
RED LAKE
NORMAN
MAHNO.
CLEARWATER
CLAY
BECKER
OTTER TAIL
WILKIN
GRANT
DOUGLAS
TRAVERSE
LAKE OF THE WOODS
BELTRAMI
HUBBARD
CASS
ITASCA
KOOCHICHING
ST. LOUIS
LAKE
COOK
AITKIN
CROW WING
CARLTON
PINE
WADENA
TODD
MORRISON
KANA.
BENTON